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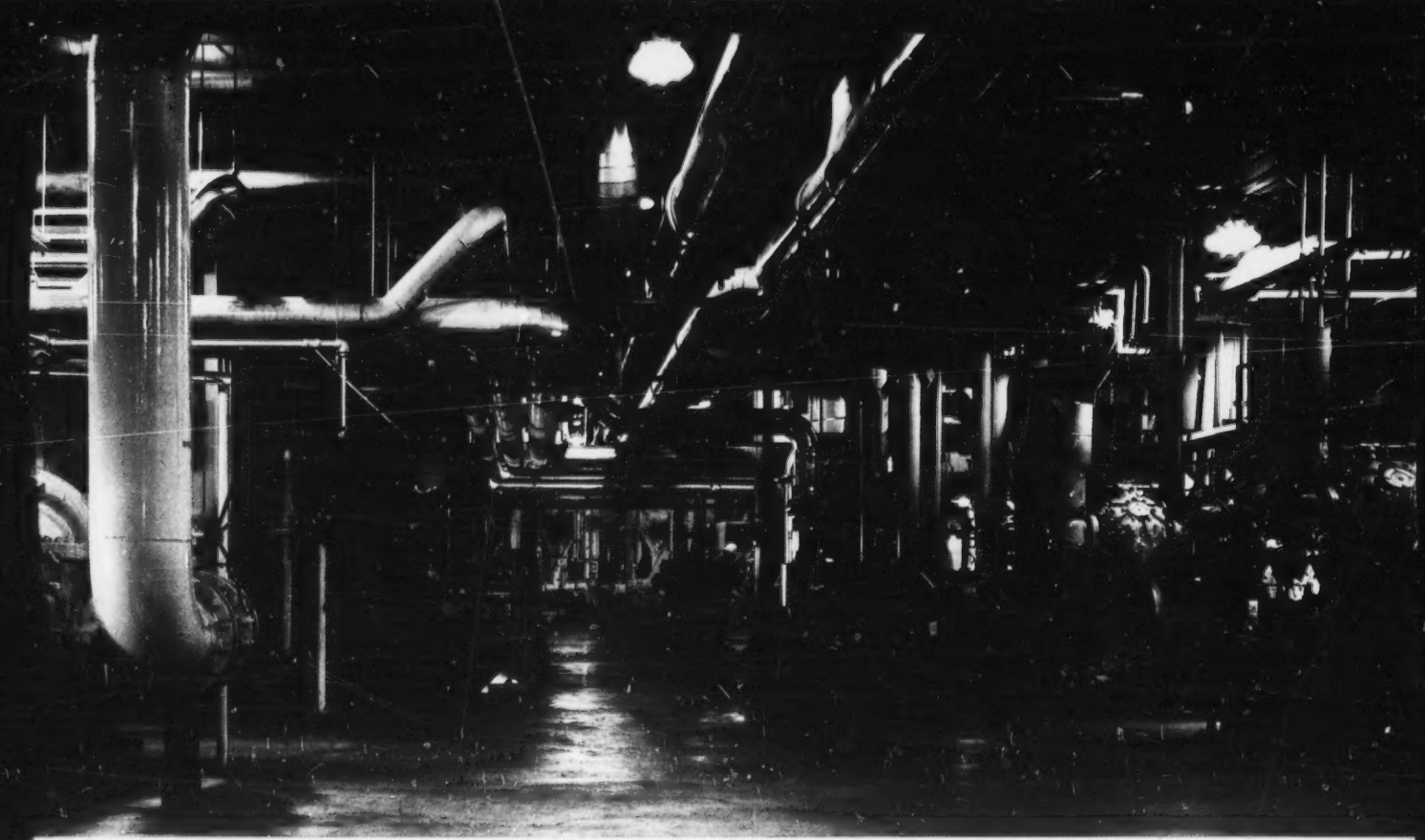
WINTER 1986

ELECTRIC PERSPECTIVES



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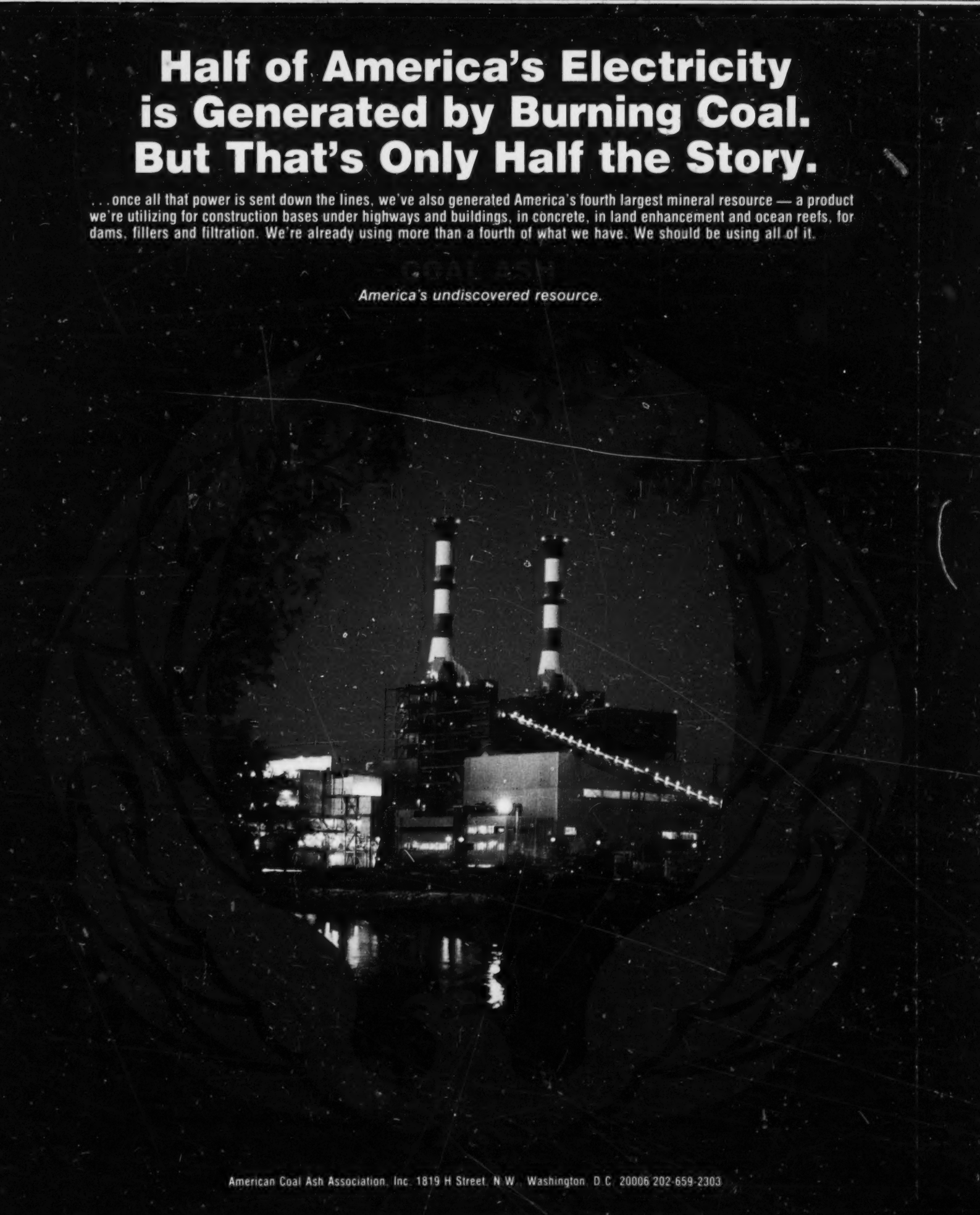

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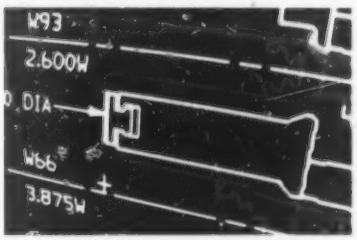

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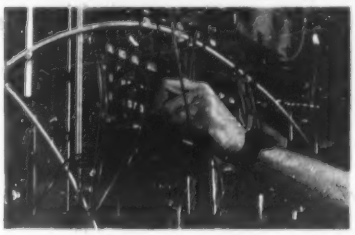

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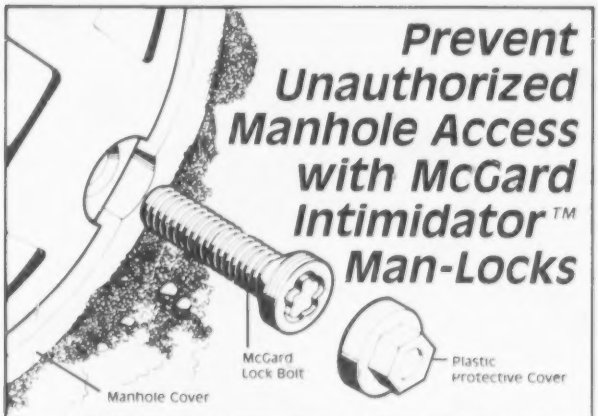

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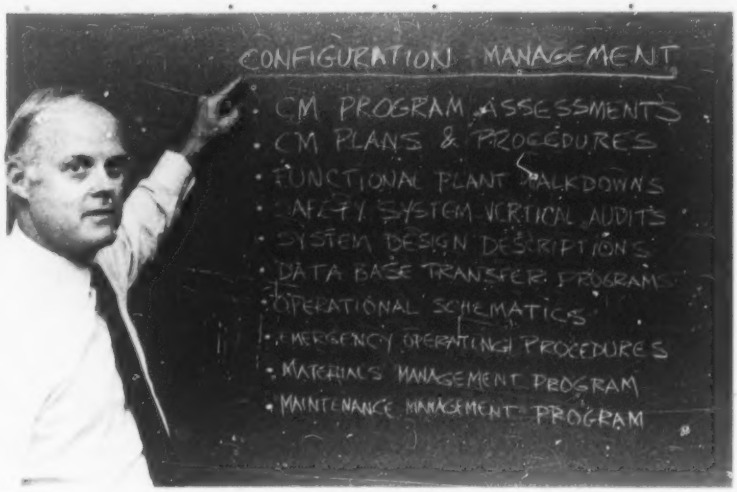
A PERIODIC REPORT FROM BURNS AND ROE — WINTER, 1986

Burns and Roe's new approach to configuration management


CONFIGURATION MANAGEMENT
• CM PROGRAM ASSESSMENTS
• CM PLANS & PROCEDURES
• FUNCTIONAL PLANT WALKDOWNS
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• SYSTEM DESIGN DESCRIPTIONS
• DATA BASE TRANSFER PROGRAM
• OPERATIONAL SCHEMATICS
• EMERGENCY OPERATING PROCEDURES
• MATERIALS MANAGEMENT PROGRAM
• MAINTENANCE MANAGEMENT PROGRAM

Bob Simmons

What does configuration management (CM) mean to you?

To many people, it means simply having electric utility plant drawings which accurately reflect conditions in the plant. But that's really only a small part of CM.

Burns and Roe's concept of CM is much more comprehensive. It encompasses:

- Ensuring that the plant engineering, operating, licensing and maintenance documents (including drawings) conform both to the applicable design requirements and to regulatory criteria;
- Ensuring that these documents are consistent with each other and accurately reflect the actual plant configuration;
- Controlling changes to the plant, and ensuring that changes are not made without authority, or without knowledge of their impact;
- Providing the necessary feedback mechanism to ensure that changes to the plant are reflected accurately—and in a timely manner—in the affected plant documents.

Bob Simmons, project manager in Burns and Roe's Nuclear Plant Services Division, sums it up this way: "Configuration management is a program for documenting on 'software' the actual configuration of the 'hardware'—that is, the plant—and for managing changes to both the plant and the software. The purpose of CM is to ensure that the software fully supports the plant. Nuclear power plants built 20 years ago may have had changes that are not reflected in the plant's technical data base, and Burns and Roe's CM program can correct that situation."

The first step in Burns and Roe's system is to look at a utility's CM program, its plans and procedures, and to assess them. While the plant may be accurately reflected in the technical data base, the data base itself may not support the original safety and operations design bases.

After that is done, plant walkdowns are performed on a sampling basis to develop a statistical confidence that the data base accurately reflects the plant's as-built configuration. If you develop that statistical confidence early, fine; if not, the plant walkdowns will need to be expanded—all the way to 100%, if necessary—until you have that confidence.

After the walkdowns, one or more of the following steps may be necessary:

- **Safety System Vertical Audits.** Their purpose is to look at all aspects of a single safety system to verify that it can meet its original safety design basis.
- **System Design Descriptions.** Unlike a simple system description, these provide the detailed design bases for the overall system and its components, collecting into one central document all the pertinent safety and operational design bases for that system. This provides the engineer who may be called on for future modifications with all pertinent design criteria.
- **Data Base Transfer Programs.** This is a system for transferring the plant's data base from the A/E to the utility; it establishes that the utility has the systems, procedures and manpower to accept and maintain the data base.
- **Operational Schematics.** These are simplified "road maps" which are a graphic representation of a power plant system, compiled and arranged on a single document to enable an operator to understand quickly what the system consists of and how it functions.
- **Emergency Operating Procedures.** These are traditionally in narrative form which the operator reads in case of an emergency. Burns and Roe offers a new approach by putting these procedures in flow-chart form, to make them easier for the operator to follow.
- **Materials Management Program.** This covers which spare parts are (or should be) in inventory, and how many of each are required.
- **Maintenance Management Program.** This covers what kind of preventive and corrective maintenance should be planned, and at what intervals.

Ten U.S. utilities with nuclear power plants have retained Burns and Roe for one or more elements of this configuration management program in recent years. For further information, please contact any Burns and Roe office.

Ron Brown joins Burns and Roe as vice president, business development

Ronald S. Brown has joined Burns and Roe Company as vice president, business development. He is based at Burns and Roe headquarters in Oradell, New Jersey, and reports to W.R. "Bus" Cobean, Jr., president of Burns and Roe Company.

A graduate of the U.S. Merchant Marine Academy, where he received a B.S. degree in marine engineering, Mr. Brown was most recently business development manager of Bechtel Power Corporation.

Ronald S. Brown

David W. James

David W. James appointed South Central Region manager

Burns and Roe has appointed David W. James as manager of its South Central Region which serves electric utilities in Arkansas, Louisiana, Oklahoma, Texas and part of Mississippi. He will be based in Houston at a new office Burns and Roe has opened at 11931 Wickchester Lane (Suite 224), Houston, TX 77043. The telephone number is (713) 558-8313.

Mr. James comes to Burns and Roe from Gilbert/Commonwealth where he was marketing manager. Previously he was a vice president of Cataract O&M Services and business development manager of Bechtel Power Corp.

Utilities are exploding with creative ways to increase their financial performance and flexibility.

Capital Ideas

Never before have so many utilities looked at ways to reshape their financial structure. What's up?

Why do some experts now predict that major changes in the financial make-up of the electric utility industry lie just ahead? Certainly the last 20 years have been tough for the industry. It has swung from financial strength to financial weakness and seems to be returning to general strength again. Yet during this difficult period, a period marked by the most volatile and expensive financial markets in modern history, there was little evidence of significant financial restructuring. Today the evidence is everywhere.

There are two major characteristics of the utility industry that set it apart from other industries. The most obvious is that it is regulated in great part at the state level. The second is that the area in which its customers reside has economic and political boundaries. Together these characteristics create a geographic identity so strong that most electric utilities take their very names from the areas they serve. (Is there any doubt where Florida Power & Light, Boston Edison, or San Diego Gas & Electric sells its product?)

The point may seem superficial at first, but its impact on electric utility companies is profound: the fortunes of the company are inextricably intertwined with the economic vitality of its service territory. One affects the other. Consequently, utility managements are intensely concerned with local issues and want to manage their companies to provide excellent service to their customers. In fact, senior executives of electric utilities usually have grown up in or near their service territories; directors include businesspeople or civic leaders from the service territory; and their customers are personally identifiable. Thus, utility managements often operate with a sense of their companies' obligation to serve that is personal or social as well as professional.

Until the last decade, utility construction decisions were relatively straightforward and simple. The companies would build in order to match or slightly lead growth because of a sense of their service obligation. Economies of scale would drive down the cost of the product, and load would indeed grow to fit the capacity, thus leading to another building cycle. Because most companies were operating in generally similar business environments and because their noncompetitive relationship to one another encouraged information exchange, managements tended to think alike. Thus, when they were confronted with similar situations and information, most of them made similar decisions, and for a long time, those decisions were correct. When planned-for demand materialized, the effect was comforting.

Editor's note: According to many financial analysts, the investor-owned electric utility industry seems poised for major financial reshaping over the next few years. Yet many of these analysts attribute to this emerging trend different causes and potential effects. Doudiet's article represents one interpretation. Other viewpoints are welcome.

An electric utility financial executive for 15 years, James T. Doudiet is now a managing director in corporate finance at Dean Witter Reynolds, Inc., New York.

New Environment

Then several things changed at once. The economy faltered under the weight of the rising price of energy and rapid inflation. Economies of scale reversed. Nuclear power, once hoped to be "too cheap to meter," resulted in many cases in power too expensive to bill. Regulatory commissions suddenly found "imprudence" in every major construction project. Working for a utility became a socially unpleasant task for some employees and for their families as well.

The reaction of most companies to external events once again was nearly uniform, and understandably so. In the face of unintended overcapacity and weak demand, the desire for new construction came to an abrupt halt. Few major utility boilers have been ordered from manufacturers for some time. This dearth of orders is perhaps the most significant result of the events of the last few years in the electric utility industry. It is not that just a few utilities have no immediate plans to build additional power plants or even that many have no such plans. It is that, almost universally, electric utilities today have no inclination or interest in building major additions to capacity. The long-term change this situation could bring to the industry is profound.

If the foregoing fully described the changes in the industry it would be important enough, but there is more. The electric utility industry was once homogenous in the sense

Union Electric Company

Gregg Mancuso Unphoto

To invest in energy or non-energy businesses? Inside or outside the service territory?

that almost all of the companies were financially sound and rates were generally similar among neighboring utilities. Today this similarity no longer holds. The last building cycle left another legacy besides a distaste for building: it left major differences in financial strength and in cost of service among some neighbors.

Now we have the conditions that suggest major financial restructuring may be imminent:

- The end of a major construction cycle.
- Growing cash flow for many companies.
- Excess capacity and low load growth expectations.
- Comparatively high rates charged by some companies.
- Growing awareness among industrial customers that they must reduce their electric costs.
- No desire by utilities to build additional electric generating projects.
- Legislative and regulatory encouragement of non-industry builders/owners of electric generation.

Before exploring the significance of these preconditions to financial restructuring, however, it is helpful to define the terms "cash flow," "financing," and "financial restructuring."

There is a great deal of confusion about *cash flow* even though the concept is fairly simple. A utility or any other type of business can have a significant amount of cash (in its various forms) running through the company. Generally, the cash flow equals the revenues collected plus money raised through financing. In any period it must match exactly the company's cash outflow of expenses paid and net investments made. Thus, in this sense, there is never any uncommitted or excess cash. What financial analysts look favorably on is free cash flow or discretionary cash flow. They ask whether, after all obligations are met, the company still has additional cash to put to work or whether the company had to sell securities to meet all of its financial obligations and thus has no discretionary cash flow. Until the last few years electric utilities had no discretionary cash flow. Now, because of the end of the construction cycle, many utilities have some cash and a few have a great deal that is not needed immediately to meet financial obligations. When this condition continues for several years, cash reserves can build up. The problem then becomes how to manage that cash most efficiently until it is needed to meet other obligations. Ironically, when a company must finance and invest in fixed plant, having discretionary cash flow looks wonderful; yet, when conditions reverse and such cash is available, the company recognizes that cash itself earns the lowest return of any asset since it is

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one of the lowest risk assets one can invest in. Additionally, as many non-utility companies have learned to their regret, cash can attract unfriendly takeover offers and other undesirable activity.

Financing as a concept also causes some confusion. There is nothing inherently wrong with financing. It is merely a way of correcting a cash deficiency in the current time period. In fact, if financing is timed properly, it can add great strength to a company by enabling the company to invest in projects that earn a return higher than the cost. Financing is "bad" only when it must be undertaken to finish some project no matter what the current economic environment, which, of course, is precisely the position many electric utilities found themselves in during the late 1970s and early 1980s. As with discretionary cash flow, the key to assuring that financing is positive rather than negative is effective management control.

Finally, there is the concept of *financial restructuring*, a term that covers many types of changes in the financial form of a company. The desired effect, however, is always the same: to improve the financial performance and flexibility of a company, usually by reducing costs or improving credit quality.

Restructuring Forms

As electric utilities have completed their current construction cycle and observed the other conditions listed earlier, many have drawn similar conclusions once again. In a desire to increase management control over the disposition of corporate assets, many utilities have formed *holding companies*. In this very modest form of financial restructuring, a new company is formed to own all of the assets of the utility in one subsidiary and to own other assets in other subsidiaries. The purpose can be to segregate the regulated assets from the unregulated assets so the unregulated assets can be managed more flexibly. To the customers and employees of the electric utility, little, if anything, changes, but, for the management and shareholders,

Cash is piling up at some companies.

Dan Dunbar Unsplash

many more business activities are available to affect return on investment positively or negatively in the future. Banks and many other types of businesses have done the same thing in recent years, and such a corporate structure is becoming quite commonplace. Very few utilities as yet have significant amounts of assets held in their unregulated subsidiaries, but it is possible that some day the role model set by Pacificorp, the parent company of Pacific Power & Light and other major businesses, could be the rule.

An early step taken by most utility holding companies has been to form a finance subsidiary to invest their discretionary cash flow. For some companies, this action has turned out quite nicely in the last few years. Unfortunately, the new tax reform act will limit some of the tax benefits of some investments, but the finance subsidiaries will still be an important part of the holding company plan.

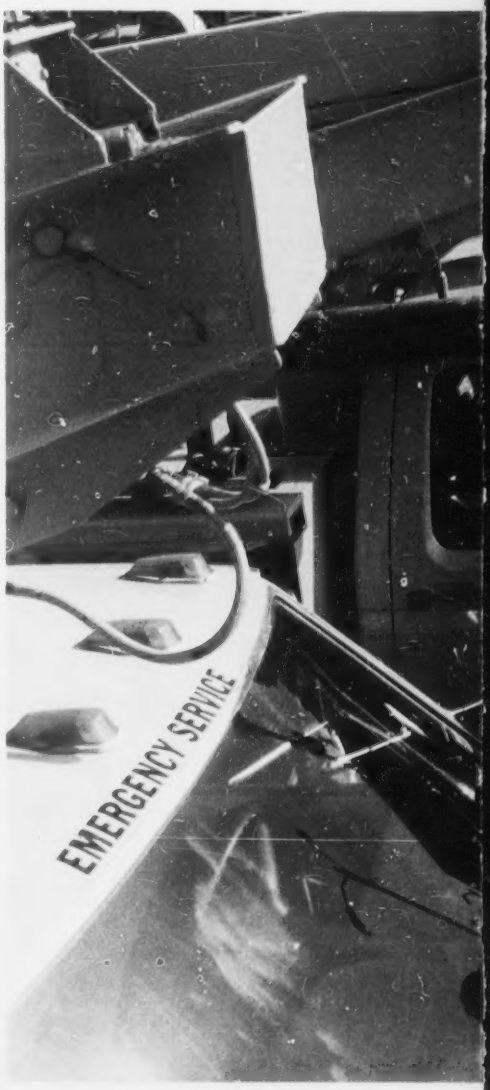
A later step has been to find other investments. Here the corporate strategy becomes all important. The fundamental choice seems to be either to make energy and non-energy investments within the service territory or to invest in projects within the energy business outside of the service territory. Each strategy has the benefit of enabling the company to stick to what it knows well, in one case its service territory and in the other the energy business. However, over time, the two paths will take a company in very different directions.

The implications of these two strategies are worth exploring. Utilities in Wisconsin exemplify followers of the first path. In their case, the state legislature would allow utilities to form holding companies only if all their investments were made within the state. The legislators' justification was that the holding company should use its capital and management talent to increase employment and economic vitality in its own state. Of course, this strategy tends to strengthen the connection noted earlier between a local economy's health and a utility's financial health, for it does not diversify the holding company geographically.

On the surface, the second strategy, investing within the energy business, makes a great deal of sense. Management presumably knows the energy business. However, the recent experience of the natural gas industry demonstrates some of the potential pitfalls of this type of diversification. The energy business is very diverse, and the expertise needed to run a gas pipeline, for example, did not transfer to managing oil and gas exploration properties. Moreover, the commonalities that do exist among energy forms tend to relate to product price. Thus, when oil prices declined, the gas business was also put under pressure, and what at first looked like a diversification of activities didn't turn out to be one at all.

Thus, the question needs to be asked: what is the purpose of diversification under a holding company? Surely it is to try to achieve unregulated returns on investment while spreading risk. Whether the forms of diversification strategy evident so far among electric utilities will prove successful in this regard is still unknown. With so many utility companies trying to diversify, however, there will be many role models, both good and bad, to observe.

Among the various forms of financial restructuring, perhaps none is so extreme as the *leveraged buyout* (LBO), in which the current management group joins forces with high-risk-oriented investors to purchase the outstanding shares of the company from the public. It is not essential that current management be involved, but having their services assures a continuance of the current operations, thus reducing one possible risk. As the name of this type of restructuring suggests, the buyout is highly leveraged through the use of large proportions of debt. It is assumed that this inherently unstable structure will itself be changed quickly. Since the common shares are no longer held by the public, the investors can



Tom Eberhart, Union Electric Company

Selling off and leasing back the company vehicles may be a good move.

agree with lenders to devote most of the earnings to reducing debt rather than to paying them out in dividends. Additionally, if a utility has discretionary cash flow, it too can be used to pay down the debt burden.

Since utilities have stable earnings compared to non-utilities and since utilities that are no longer building major construction projects tend to become current generators of discretionary cash, some observers have suggested that such utilities will be candidates for LBOs. To date, there has been only one such takeover completed. The Alamito Company, itself created from a stock distribution to shareholders by Tucson Electric Power, was purchased by a subsidiary of Catalyst Energy. The economics of the transaction are somewhat obscure, but in this case management was outbid for the LBO. Public Service Company of Indiana recently received a takeover offer from a non-management group that was later withdrawn.

After several years of operating successfully and paying down the debt to the extent that the debt/equity ratio is no longer out of line with the industry standard, the new management may choose to reverse the process by "going public." This reversal entails the management selling most of its stock in the utility to the public. If the management was correct about its abilities to improve the operations of the utility, the stock of the utility should be sold at a significant premium to its original LBO price. It is somewhat uncertain how this would work in the regulated, price-sensitive environment in which most utilities will probably be operating in the next few years. It is possible that the benefits management hoped to capture for itself will go to the ratepayers as has happened so often in the past. On the other hand, those individuals behind large pools of risk-oriented money have proven very successful in recent years in using LBOs in other industries.

Another less extreme example of financial restructuring is found in the *sale and leaseback* of property. The usual approach is to sell some new piece of equipment to a group of investors that has access to a cheaper funding source than the utility, a more immediate use for tax deductions than the utility, or both. The pieces of property can be as mobile as automobile fleets or as stationary as portions of nuclear power plants. With the proceeds from the sale, the utility will pay for additional property under construction. If there is no more construction, it might retire high-cost securities currently outstanding. By leasing back the property, the utility has the use of the equipment and the obligation to maintain it just as if it were still owned by the utility. The main advantage of a sale and leaseback is the opportunity to reduce the current cost of service, even though in some cases rates might be higher in the distant

Chuck O'Rear / West Light

Industrial customers are looking for the low-cost power producers.

future because of this restructuring.

Another type of financial restructuring deals with the proper *mix of debt, preferred stock, and common stock* in the capital structure. This mix has been important in the past as utilities have tried to raise huge amounts of capital to fund their building programs. Maintaining an appropriately high credit rating was very difficult as earnings and cash flow lagged behind what was needed.

Now that most building programs have ended, there is a new reason to consider financial restructuring to change capitalization ratios, and that reason is price competition. There is little doubt that the electric utility industry is entering a new competitive era.

Implications of Competition

There are some broad statements we can make about this new era. First, as in all competition, there will be winners and losers. Second, the only two ways customers can distinguish among products are service and price, and after years of

Blair Hess, Black Star

building service capability, most electric utilities should be able to deliver superb service. Therefore, it is most likely that competition for electric load in the future will turn on price. Thus, electric utilities that are low-cost producers will be winners. Those that are high-cost producers will be losers.

There are several aspects to the price a utility must charge for its service that didn't seem to matter in years gone by, but that do matter today. Customer mobility is one example. Some customers are locked-in or "core" customers, but others are finding new freedom to threaten to leave a utility's system. Where do they threaten to go? They may go into self generation where new technology may offer lower electric rates. They may municipalize and engage in the wholesale purchase of electricity. They may even try to be served by neighboring utilities. Transmission access is becoming a major strategic and legal issue.

However, we suspect that only one thing will ultimately be important—the level of rates a company must charge to recover its cost of service relative to the rates charged by its neighboring electric producers. In considering who the neighbors are, it is necessary to expand our thinking beyond those companies that are physically adjacent. Once the universe of neighbors is defined, the next inquiry should be into relative rates. We know that in general rate levels have long been very different in various parts of the country.

The highest rates in the state of Washington, for example, are lower than the lowest rates in the state of New York. Fortunately for the companies in New York, the companies in Washington are too distant to be neighbors. Recently, however, rates of true neighbors to New York utilities have remained relatively low while rates in New York have risen substantially.

We have begun to find significant differences among the rates of neighboring companies in several parts of the country. Where the rel-

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Midwest Energy Company

Midwest Energy, a holding company with major electric and gas utility operations, acquired a storm door and window manufacturer in 1985. Midwest also has investments in food processing and telecommunications.

ative rates are far apart, stresses may occur. These stresses may take the form of customer dissatisfaction or outright attempts "to migrate" to the system of the low-cost producer. Such migration would be harmful to the remaining customers of the high-cost neighbor, for the fixed costs formerly paid by the departed customer must be shared by the remaining customers, further increasing their rates. This rate increase, in turn, would encourage other customers of the high-cost producer to leave the system, thus repeating the cycle. Some observers have referred dramatically to this sequence of events as a "death spiral." While that characterization seems somewhat extreme, it is in fact the strongest threat to the continued existence of the highest-cost producers in the electric utility industry today.

It is so much of a threat that it should be at the center of the strategic thinking of all electric utilities. In essence, the relative cost of service may become the most important fact about a company in the future. Consequently, it is necessary for utilities to investigate the elements of their cost of service to see if financial restructuring can help solve this problem.

There are three major elements of a utility's costs. These are the cost of fuel; the costs of operations, maintenance, and taxes; and the cost of capital. The effect on total cost of each of these elements varies widely from utility to utility. In a highly price-sensitive environment, companies will have to search for cost savings wherever they can be found, and conflicts between costs and value derived from such costs are sure to be troublesome. For example, the fuel procurement people could design a least-cost fuel strategy that also would have uncertainty of fuel supply as a consequence. The maintenance people could design a least-cost maintenance schedule that would increase the probability of a major outage as a consequence. Likewise, the chief financial officer could design a least-cost capital structure that would increase the probability of the company not having access to the capital markets at all times. Of course, none of those professionals would advocate taking such risks, but competitive pressures may force some to try to come close to the limits dictated by prudence.

Capital Structure Planning

A more reasonable balance is struck if one looks at the need to be price competitive in the context of continuing the service obligation as well. In the area of the cost of capital, being competitive means balancing the desire for the lowest cost of capital with the desire to maintain credit quality at a reasonable level. There are two fortunate events which have recently taken place that are important in developing a least capital cost strategy today.

One is the dramatic reduction in the cost of debt and the related increase in the price of the common stock of most electric utilities. The impact of the opportunity to reduce capital costs through refi-

nancing outstanding debt can be significant, particularly for utilities that have had to raise large amounts of money in the last five years to complete construction programs. Since very high costs of debt resulted from such financing, this is one source of the relative rate differential now observed between such companies and neighboring utilities that were not engaged in their building programs at the same time. Thus, as refinancing occurs, we should expect relative rate differentials to diminish.

A second major event is the forthcoming revision in the federal tax code, which, among many other things, will lower the marginal corporate tax rate from 46 percent to 34 percent. This reduction will make debt relatively more expensive compared to equity than in the past because interest expense, although still tax deductible, will not reduce taxes as much as previously. This change, combined with the much higher common stock prices and the lower returns on equity allowed by commissions, means that the impact of increasing common equity ratios should be substantially less than in the past.

The proper mix of debt, preferred stock, and common stock in the capital structure may be important in price competition.

Steve Brady, Houston Industries Incorporated

Thus, one might expect a tendency away from debt and toward equity for those companies that are already price competitive but that are concerned about credit quality. For companies with relatively high prices compared to their neighbors, there may still be a reason to focus on lowering their capital costs by adding debt, although it means reducing credit quality. In each case, too many variables are at work to generalize about which financial restructuring strategy makes the most sense, but it is clear the number of options open today for a company to impact its cost structure favorably are greater than at any time in recent memory.

Where Will It Lead?

The electric utility industry today finds itself at a point of transition from an era of high capital costs, massive construction-related financing programs, and little or no competition with other electricity suppliers to an era of lower capital costs, much reduced construction-related financing needs, and growing competition based almost solely on price.

Financial restructuring, running from the formation of holding companies and leveraged buyouts of operating facilities to more traditional changes in capital structure, is already evident. We are seeing only the beginning. EP

Utilities are looking into quick, profitable ways to make older facilities last longer and perform more efficiently.

Invest in Your Power System Now

Modernization can be fast, the payback short, and the returns excellent.

The window of opportunity is wide open to upgrade and modernize electric power systems. Between now and the next few years, as many utilities are finding, such strategic investments will be crucial to meeting customer demands and to surviving in an increasingly competitive business environment, and they will bring excellent returns.

Many U.S. electric utilities are now in a transitional period. These companies have completed their major generation capacity additions begun more than a decade ago, and they do not foresee the need for new capacity until the early-to-mid-1990s. They are also financially healthier, with return on equity, interest-coverage ratio, and market-to-book ratio at much improved levels. Their cash flow trend has been upward, with cash from operations as a percentage of capital expenditures having increased every year since 1979.

As utilities look ahead, they are projecting a continuation of the low load growth of recent years. Peak demand growth rates of 2 percent to 2.5 percent over the next 10 to 15 years are typical. As a result, taking into account the existing committed generation resources, new capacity is not required until the mid-1990s (see Figure 1). But, by about the year 2000, the United States will need slightly more than 100 additional gigawatts of as yet unplanned-for power. New plants to generate this electricity will require a significant capital investment in the next decade.

Stretching System Life

Another result of this reduced load growth is that less new equipment is being added annually to the power system, from generation to distribution. As a consequence, system age has been increasing, posing the risk of more forced outages and system unreliability.

When load grew at 7 percent per year, average system age tended to level off at about 11 years. With only 2 percent load growth, the average system age will approach 25 years. This aging is of some concern because reliability data suggests that major power equipment, such as turbines, transformers, and circuit breakers, are more prone to failure after 20 years or so of service. Simultaneously adding new capacity and making major upgrades of existing equipment in the 1990s could pose a serious financial burden for utilities.

Data on existing fossil fuel plants indicates that the percentage of plants that are 30 years old or older will triple from 1980 to 1992. Even more alarming is the fact that the percent capacity of these old plants will become greater than the U.S. capacity margin by the mid-1990s (see Figure 2).

The increasing age of the transmission system is also of concern because transmission is now playing a more important role in energy transfer. Department of Energy data indicates that over the last decade the amount of economic energy transfer has tripled and could reach the equivalent of 50 gigawatts by 1990, assuming a 50 percent capacity factor. Reliable transmission could prove even more critical in the future as a greater number of utilities depend on it to link them to firm capacity at a neighboring utility.

Frederick J. Ellert is general manager, Systems Development and Engineering Department, General Electric Company, Schenectady, New York.

Lower Power Losses

One other very important factor is fuel prices and the resulting high values many utilities have placed on power losses. In response, manufacturers of electrical equipment have redesigned their products for much lower losses. The replacement of old, high-loss equipment with modern, low-loss designs can achieve substantial savings by reducing production costs and deferring new generation capacity.

Strategic investments in the power system will help utilities to improve financial results and to respond more effectively to external pressures. Financial results can be improved through plant life extension, a reduction in losses, and an increase in system reliability. External pressures from a public demanding lower rates and from competitors offering cheaper power can be dealt with more effectively if the utility is a low-cost producer of electric power. These investment opportunities exist throughout the power system: the power plant, the transmission system, and the distribution network.

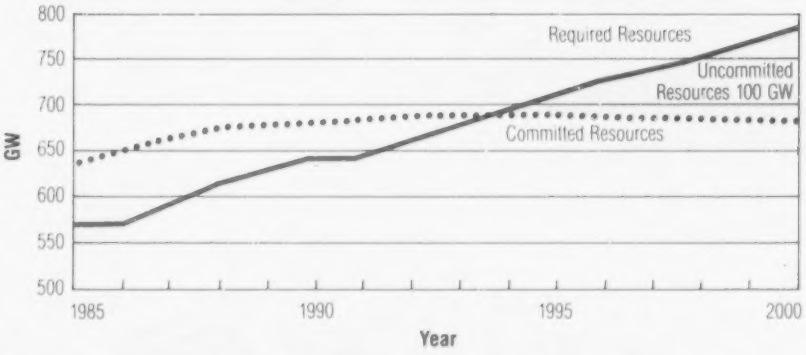
Economic Benefits

Power plant investment opportunities include upgrades of the steam

Ronald Wilson May

Figure 1

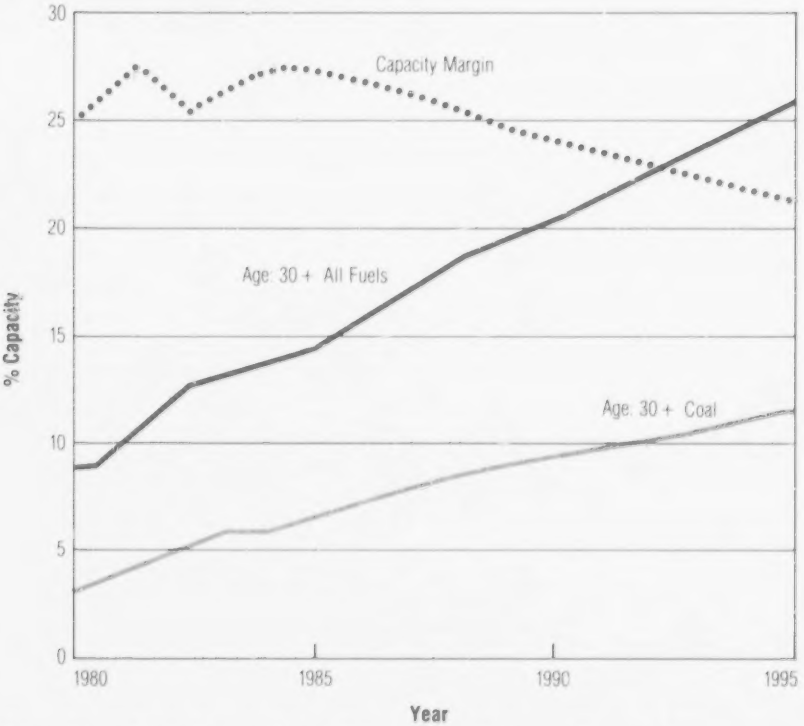
Major Investment Required for New Generation Resources in the Early 1990s



Source: General Electric Company, Systems Development and Engineering Department

Figure 2

Old Plants Are Becoming a Significant Fraction of Capacity Margin



Source: General Electric Company, Systems Development and Engineering Department

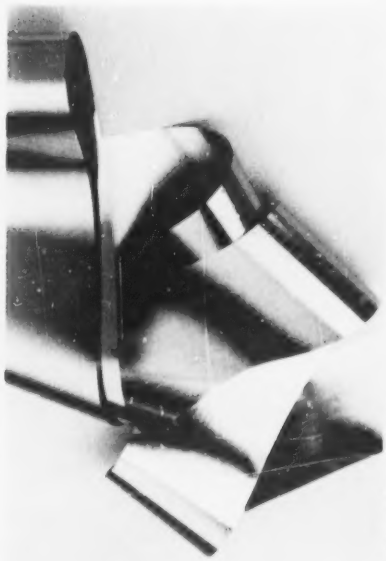
supply and turbine-generator as well as modernization of the auxiliary system. For example, in the turbine area, replacing rotors, shells, or blades should be considered. New technology is available to reduce the wear caused by solid particles in the steam. In addition, the turbine can be modernized by a retrofit automatic control system.

The economic benefits of such investments can be substantial. Consider the case of upgrading a turbine with new high-efficiency blades in the last stage of the low pressure section. The benefits include an improvement in both heat rate and capacity of 1 percent, an increase in plant availability of 0.2 percent, and reduced annual maintenance costs.

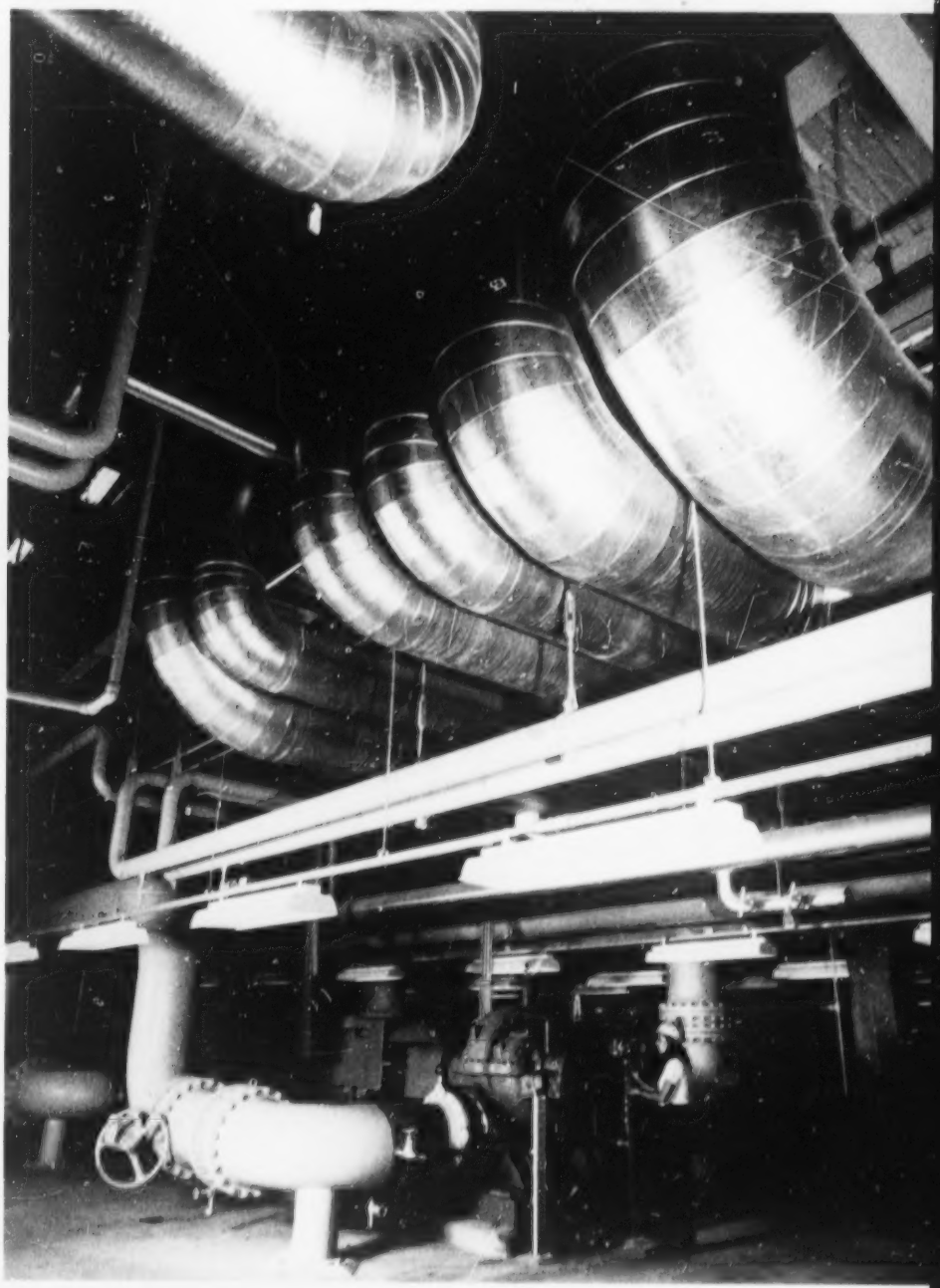
The annual return, based on a 400-megawatt plant burning coal at $1.70 per million Btu, would be about $1.1 million. By comparison, the investment in components required for a four-flow turbine would be about $2.7 million, resulting in a payback period of less than three years.

Similar benefits can be obtained from investments in the steam supply. For example, extending the life of a 670-megawatt boiling water reactor's nuclear steam supply for an additional 20 years would require a capital investment of about $90 million and would yield a capitalized return of $680 million (1986 dollars), giving a benefit-to-cost ratio of almost 8. The investment would cover the new equipment as well as the licensing costs. The principal benefits would be the production cost savings and the capacity credit for deferred generation additions.

The power plant auxiliary system offers one of the best opportunities for improving plant efficiency and reliability. In recent



Ronald William May



Joseph Devlin Upton

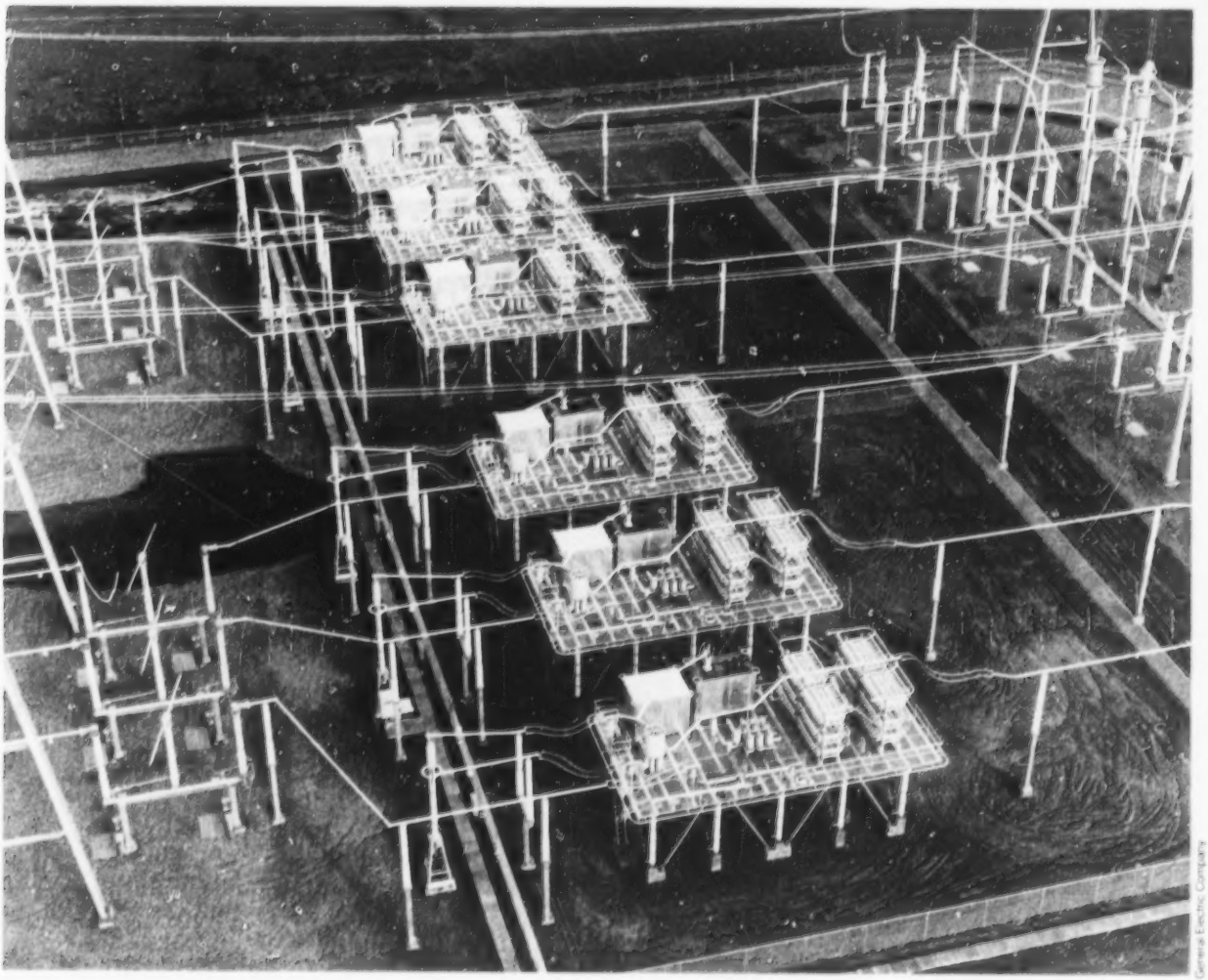
Above: Amorphous metal in transformers can cut core loss by 60 percent.

Right: Steam supply upgrading can pay for itself many times over.

years, great progress has been made in the performance and economics of adjustable-speed drives, high-efficiency motors, and static generator excitation systems. Alternating current adjustable-speed drives have been applied on induced and forced draft fans, primary air fans, boiler feed pumps, condensate pumps, and circulating water pumps. The benefits of these modern solid-state drives include reduced energy consumption and the associated released generating capacity, less mechanical wear, reduced motor starting duty, and relaxed motor starting restrictions.

In just one example, consider the installation of a 4,000-horsepower adjustable speed drive on an existing boiler feed pump motor. The benefits include 338 kilowatts less power required at 100 percent unit load. This translates into an annual saving of 5 million kilowatt-hours per pump based on a typical load profile. The capitalized return for two pumps in a 250-megawatt plant would amount to about $2.5 million, assuming a production cost of 3.5 cents per kilowatt-hour. The investment required for two induction motor drives would be just under $1 million, giving a net capitalized return of about $1.5 million, or a benefit-to-cost ratio of under 3.

Another opportunity for savings arises when small motors fail. There may be 50 to 200 of these motors in a large power plant. When the failure occurs, the utility has the option of rewinding the motor or replacing it with a modern, high-efficiency motor. The benefits of replacing a failed 40-horsepower motor with a high-efficiency General Electric Energy



General Electric Company

Series capacitors are a good bet for major increases in power transfer capacity on existing transmission rights-of-way.

Saver™ unit, for example, include an annual energy saving of 10,400 kilowatt-hours and a 1.7-kilowatt increase in usable plant output. The purchase price of the new motor is approximately $1,000. The net investment required for the new motor is about $300 when taking into account the facts that the initial rewind is avoided and the failed motor has a salvage value. The capitalized return of over $5,000 is due principally to the energy saving and the value of released generating capacity. This gives a net capitalized return of about $4,800 for a motor with a net initial cost of about $300. Even if there were no released capacity value, the net capitalized return would be over $3,000. This is a good example of the benefits to be derived from making a strategic plan to modernize a power system. If that were not done, the failed motor would undoubtedly be rewound because that decision would have been made without a clear picture of the overall economic benefit.

There are many other opportunities to modernize generating station auxiliaries, including static retrofit excitation systems; large high-efficiency motors; low-loss transformers; silicone-filled load center transformers; vacuum metal-clad switchgear; and high-efficiency, high-illumination station lighting. For a typical plant, the overall financial returns can be substantial.

"Old" Versus "New"

One very obvious benefit of upgrading an existing power plant versus building a new one is that the existing plant is already tied into the power system and no added transmission equipment is required. For a new plant, the cost of the associated substations and transmission line could range from $50 to $150 per kilowatt, depending on the voltage and distance involved. This factor, plus all of the other problems and costs associated with new power plants, has caused some utilities to seriously

consider rebuilding retired units and bringing them back on line.

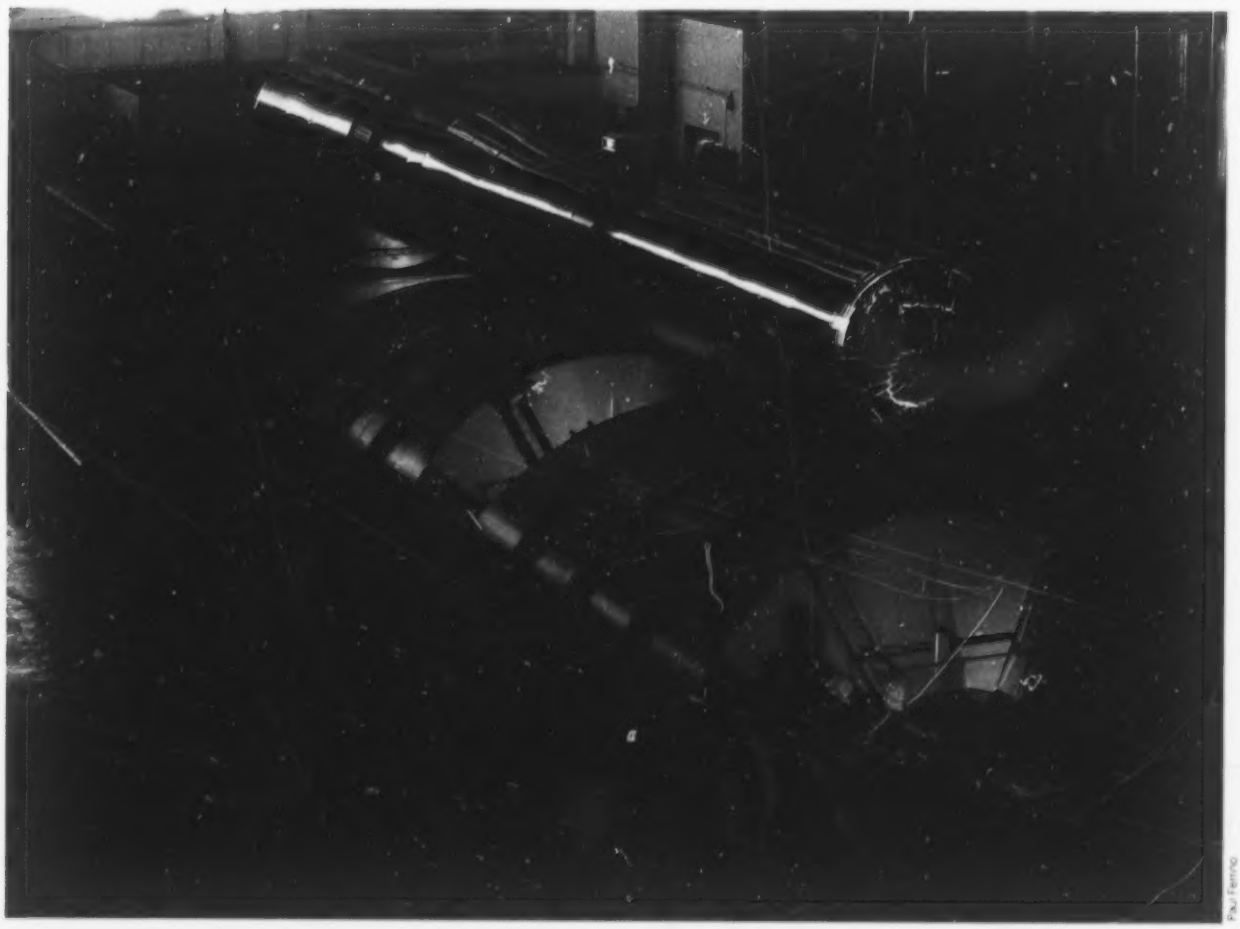
Transmission and Distribution

There also are significant investment opportunities in the transmission and distribution areas. They fall into three general categories: transformer and capacitor replacements, enhancement of transmission capacity, and improvements in transmission and distribution system effectiveness.

The replacement of old power transformers with modern, low-loss units can result in important energy savings. Since 1960, a 50 percent reduction in losses has been achieved through better core materials, thinner laminations, and the use of more copper in the windings. In addition, significant improvements have been made in the short-circuit strength. The value of the reduced losses alone can equal the price of a new transformer with the higher reliability providing added benefits.

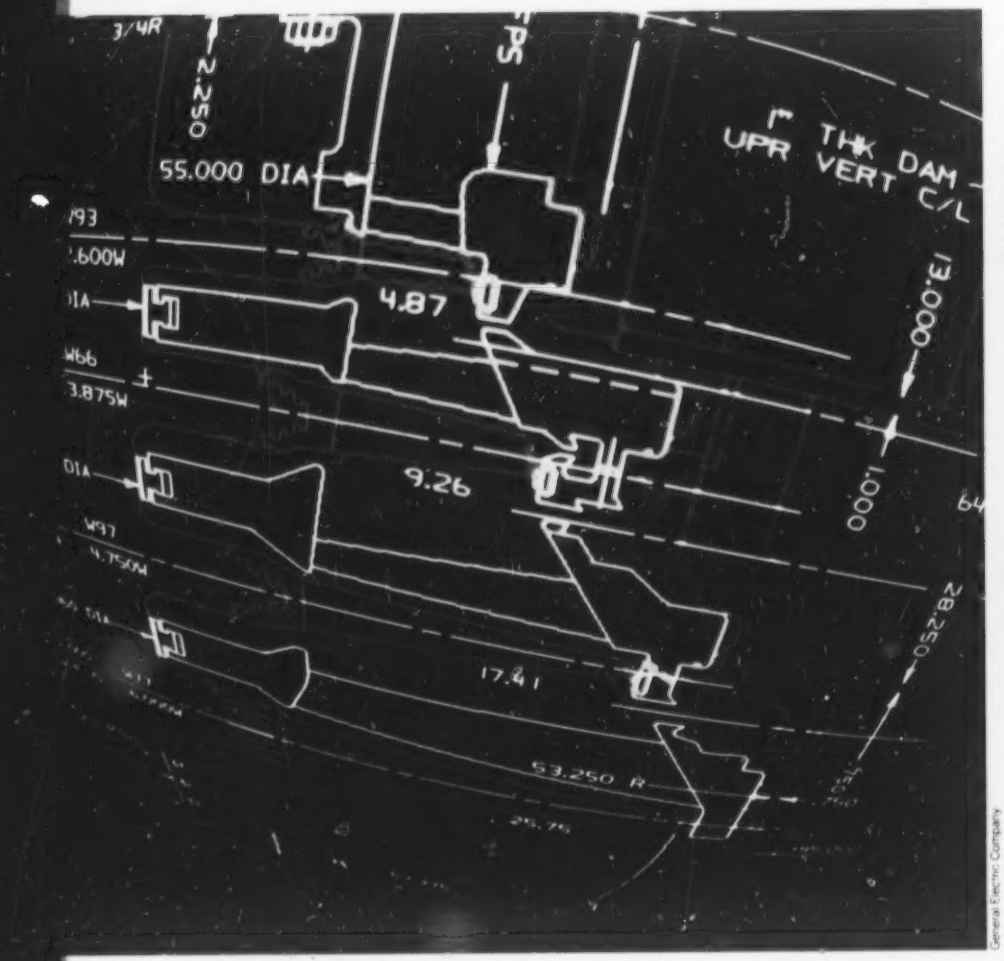
A financial analysis also shows that it is more economical to replace many distribution transformers with modern low-loss units than to reuse them. To achieve the greatest possible loss reduction, the new amorphous-metal transformers should be considered because their core loss is 60 percent less than that of silicon steel.

To appreciate the economics of transformer replacement, consider a 25-year-old autotransformer rated 210/280/350 megavolt amperes (MVA). This transformer has a total loss of about 1,100 kilowatts. A modern transformer of the same rating will have about half the losses, giving a reduction of 525 kilowatts. The capitalized value of this loss reduction is just under $1 million based on no-load losses evaluated at $3,320 per kilowatt and load losses evaluated at $1,300



Upgrading turbine rotors, shells, and blades is well worth the investment.

Paul Fenno



General Electric Company

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Computers aid in turbine upgrading (above) and stress analysis (right).

per kilowatt. The investment required for the new transformer is just over $800,000, giving a benefit-to-cost ratio of slightly greater than 1. The new transformer would also have much greater short-circuit strength.

Recently, there has been a great deal of discussion regarding transmission access and the need to make more effective use of existing transmission rights-of-way. The power transfer capacity of existing lines can be substantially increased by adding series and shunt compensation or by converting the AC lines to DC. Where a significant increase in power transfer capacity is required, series capacitors should be considered. Where high-speed voltage regulation is needed, a static volt amperes reactive (VAR) control is the ideal solution.

In many cases, the best overall solution is to use these two types of equipment in combination. For example, consider a 300-mile, 500-kilovolt transmission line. Without series or shunt compensation, this line would be capable of carrying about 1,000 megawatts. To double the power transfer without significantly affecting system stability, the best solution would be to add 500 megavolt amperes reactive (MVAR) of static VAR control at the middle of the line and to install 1,200 MVAR of series capacitors. The total investment would be about $27 million. Assuming an en-

ergy cost differential of 1 cent per kilowatt hour, the additional 1,000-megawatt transfer capability would yield a daily return of $120,000, giving a payback period of 225 days. Studies of other similar situations, with energy cost differentials of 1 to 3 cents per kilowatt-hour, indicate that the payback period is very short.

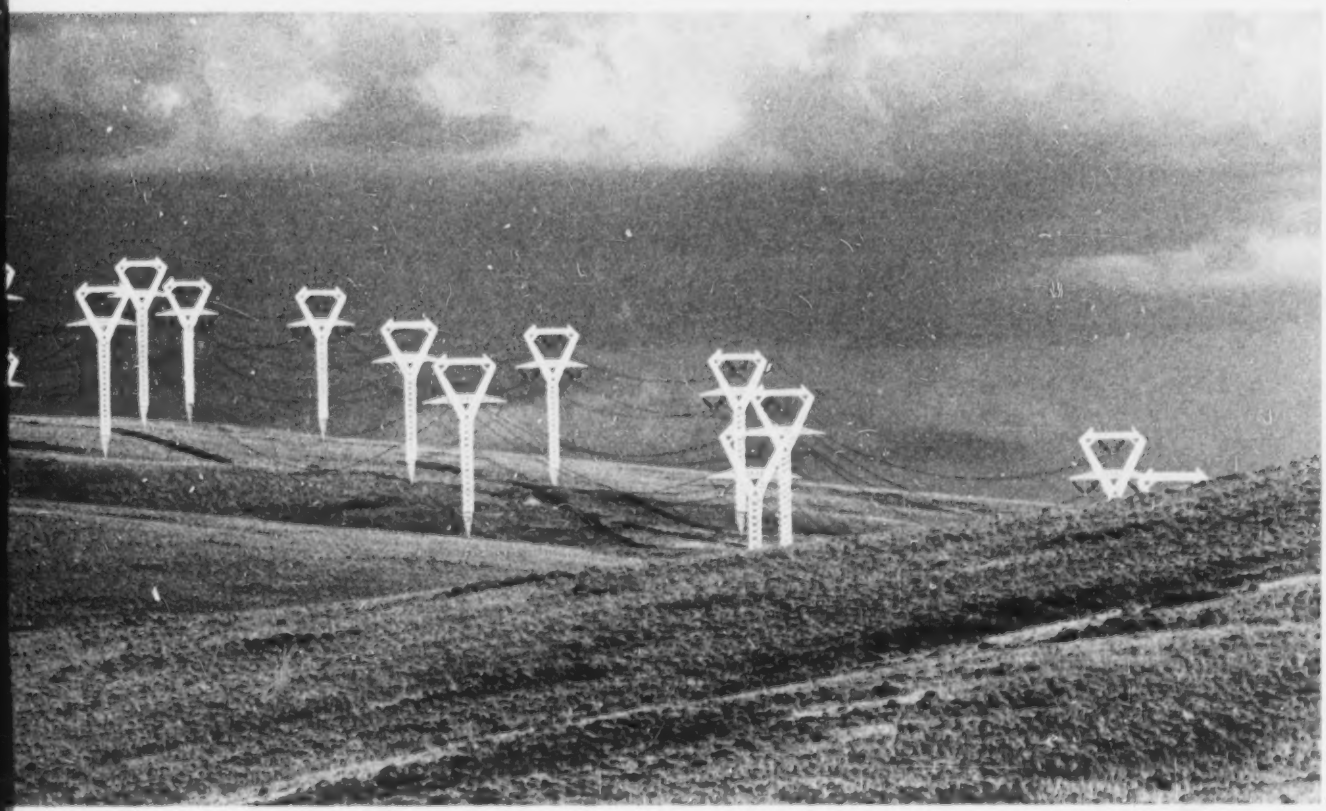
Another means of substantially increasing the power transfer capacity over a given transmission right-of-way is to convert an existing AC line to DC.

For example, a 230-kilovolt, 300-mile AC line carrying 150 megawatts could be converted to a ±180-kilovolt DC line carrying 485 megawatts without changing the existing conductors or insulators. If the AC insulators were replaced with new DC units, the voltage could be raised to ±335 kilovolts and the power transfer capacity would become about 900 megawatts. Similarly, a double circuit AC line could be converted to a hybrid line with both AC and DC circuits. For a long double circuit 345-kilovolt AC line carrying 375 megawatts on each circuit, the conversion of one of the AC circuits to DC would increase the overall transfer capacity to almost 1,900 megawatts. If the energy cost saving associated with this increased power transfer was 1 cent per kilowatt-hour, the payback period would be less than two years.

Transmission and distribution systems also can be improved by using zinc-oxide arresters, substation automation, and electronic demand meters.

Now is the Time to Invest

Many utilities already are taking advantage of the many good opportunities to modernize existing power systems to achieve increased capacity, lower losses, higher reliability, and greater effectiveness. As these companies are finding, these improvements can be made quickly and do not require excessive capital outlays. Most important of all, the payback periods are short. But timing is everything, and a utility's business strategy needs to make room for these crucial near-term investments—before the window of opportunity closes.



Converting an existing AC line to DC can multiply the amount of power carried at significant cost savings.

Ronald William May

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Competition, Strategic Planning, and Running Dogs

Strategic planners need to see competition as dogs see chasing cars: it's the pursuit that counts.

Asking electric utility managers to turn the company loose to compete in an unregulated marketplace is a bit like asking a dog to chase a car. One breed of dog—called an "economist"—thinks it is a great idea. Chasing a car provides good exercise for the species and sharpens the wits of the driver. Another breed—called a "seasoned practitioner"—is rather more skeptical. From experience, this one knows that it can be dangerous to both the car and the dog.

And then there is a third breed, one that asks what to do with the car once it is caught. We call this breed a "strategic planner."

Now it turns out that we give a good deal of credibility to the economist. After all, chasing cars does produce the mental discipline and physical exercise that a less rigorous regime might not. A dog practiced in the art of chasing cars successfully is likely to be healthy and lean.

And we give a good deal of credibility to the seasoned practitioner. We all know that chasing cars is not without its risks. A dog accustomed to a daily walk or even a vigorous run through the field will confront the prospect of chasing a car with some trepidation—or ought to. Some that attempt to do it will not succeed. For some the consequences will be fatal, for others merely painful. And few drivers see the immediate benefit of being chased by a dog; it's just one more thing to contend with.

Barking Dogs and Strategic Planners

While we listen to the barking of the economists and practitioners, we tend to pay little attention to the strategic planners—despite the fact that we bred the strategic planning line to provide us with advice precisely when we confronted difficult and unfamiliar challenges like those involved in chasing cars.

When it comes to the problem of the dog and the car, it is fairly obvious why we ignore the question posed by the strategic planners. While they are asking an apparently logical question, it is also a transparently silly question. A dog does not actually chase a car with the expectation of catching it; therefore, to ask what the dog will do once it catches the car is logically correct but contextually ridiculous.

The Real Challenges of Strategic Planning

And so, all too often with competition and strategic planning in the electric utility business, we listen to the economists and the practitioners but frequently ignore the planners—and often because they are asking logical questions, but not necessarily ones that address the real challenges of competition.

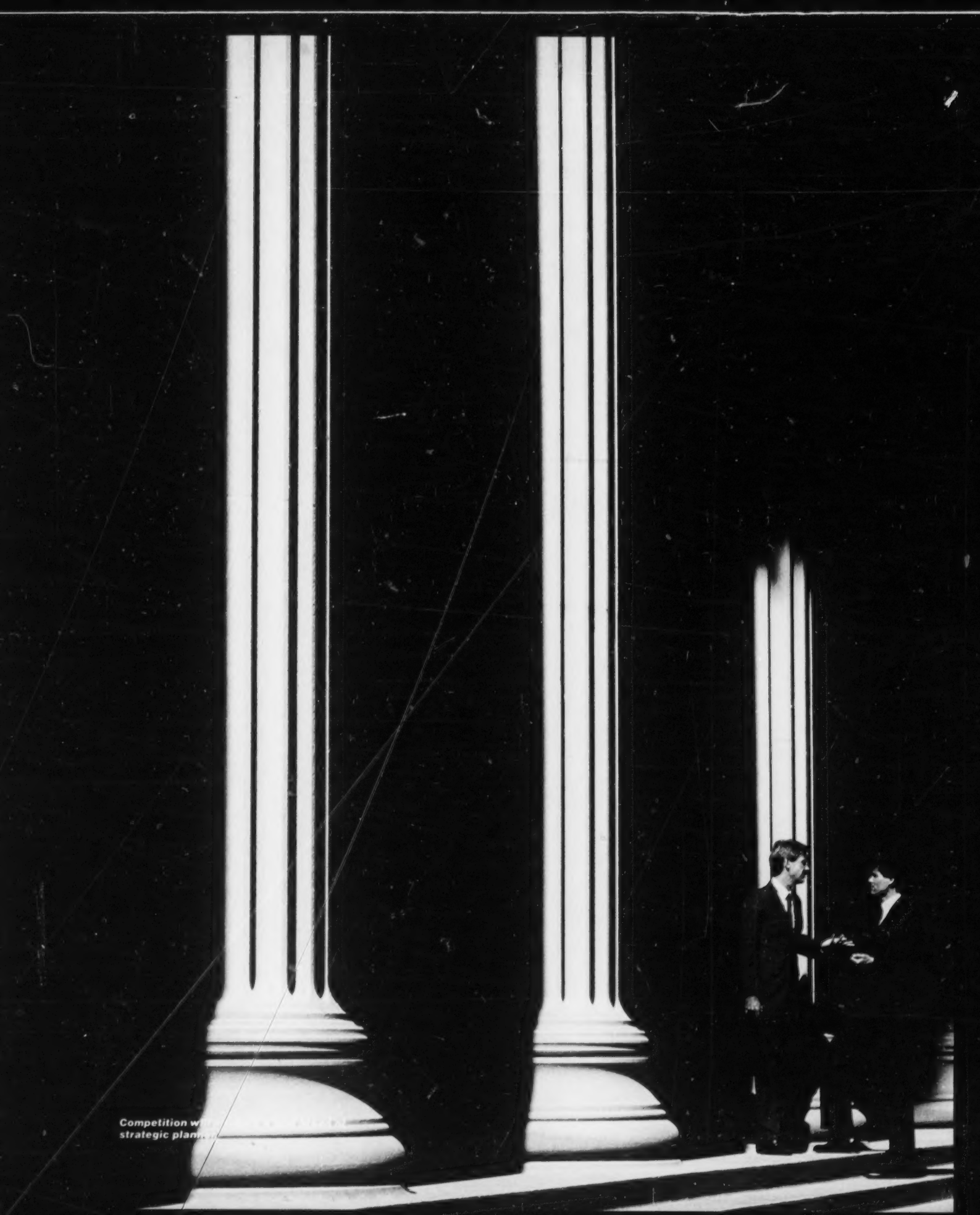
Robert A Leone is an economist and management consultant. He teaches operations management at Harvard University's John F. Kennedy School of Government and is a principal of Putnam, Hayes & Bartlett, Inc. His most recent book is* Who Profits: Winners, Losers, and Government Regulation *(Basic Books, 1986).

Thus, utility planners today can tell us what load growth would look like under almost any number of alternative scenarios. The sophisticated ones can even account for patterns of covariance in the uncertainties of input parameters. But very few can cope with the fact that the electricity the company sells is a multidimensional product which counts among its attributes reliability (blackouts, expansion capacity), quality (volts, cycles), time of delivery (time of day, time of year, duration, start-up), and cost (predictability as well as level).

Competing effectively means paying attention to the marketability of each of these specific characteristics of electricity, yet, at present, strategic planners have little to offer management in this critical area. This is not to criticize individual planners. The science of planning simply is not as advanced as competitive market circumstances will demand.

Utility planners can usually tell us how future costs will vary with fuel costs, capital costs, or labor costs. They can account for uncertainties regarding these variables in their complex computer models with a precision and sophistication that is as awesome as it is expensive. But competition makes many of these uncertainties unimportant and possibly irrelevant. It is not the absolute cost of fuel, labor, or capital that is important to a competitive enterprise but the cost relative to the competition. As long as all

Julie Houck / Unphoto


Competition w
strategic plan

Clark Dunbar/ Unipholo

Planners must look at markets with both the outsider's and the insider's eye.

fuel prices are rising, a competitor can likely survive, but even modest deviations from the behavior of one firm's fuel prices relative to another can be the difference between profitability and bankruptcy in swift order.

Today, because so much planning supports activities in the regulatory arena, there has been no need and there is little time for planners to devote their efforts to "competitive analysis." Utility planners, almost as a matter of professional ethics and certainly as a matter of regulatory pragmatism, tend to remain distant from the political forces that shape a utility's relationships with its regulators and publics.

A Sad Fact

But competition brings a fundamental change in the political and institutional context in which utilities must operate. Many of these political changes are even more important sources of uncertainty than the energy and demand uncertainties that regularly receive planners' attention. Uncertainty in energy prices is tough enough to cope with, but consider the added uncertainty of competing in a marketplace partly controlled by regulation and partly controlled by forces of competition and where the balance between the two is a political decision. No manager can expect to devise an effective corporate strategy without an appreciation of these new political realities, yet strategic planning as currently practiced tends to offer little guidance in this important area. The sad fact is that, in too many utilities today, planners feed the regulatory process better than they do their own management.

Competition is a Process, Not an Outcome

Competition is something economists love to talk about. Viewed as an economic matter, competition is a cold, hard, calculable reality regarding relative prices, elasticities of demand, economies of scale, and the like. But competition is not merely an economic abstraction; it is a managerial reality. Economists tell us that markets will clear and that supply will equal demand. They are right, but it is managers and consumers, not economists, who bring about this equilibrium, and the equilibrium point can be affected by managers.

Outsider and Insider Perspectives

Economists look at markets from the outside, but managers look at them from the inside. Indeed, when economists look at today's marketplace for electricity, many of them still see the old market with big institutions ready to exercise

Promises made.

Promises kept.

We're number one. More precisely, the $450 million worth of systems we've installed in the last 18 months in the U.S. makes us the leading supplier of transmission systems to the U.S. electric utility industry.

We're proud of our position, and we're proud of how we got to the top: by keeping our promises. All of the above projects were completed on-time and within budget.

We plan to stay number one, so we plan to stick with our winning formula: Innovative transmission systems that meet the challenges of changing times. And hardworking, always-available project teams that make sure we meet your deadlines.

Here are some of our recent success stories. Give us a chance and your next transmission installation will be among them. That's a promise.

Static Var—We've completed three thyristor-controlled static var projects for electric utilities in the U.S. (Kansas Gas and Electric) and Canada (Hydro-Quebec) over the past 3½ years. Their total capacity, 2,355 Mvar, represents almost 80% of the market and four times that of our nearest competitor.

Series Compensation—We come out on top here, too. The totals: four projects (two each for Pacific Gas and Electric and San Diego Gas and Electric) representing 2,293 Mvar over the last 3½ years.

GIS—We're responsible for nearly 30% of all the GIS installations in North America 500 kV and above over the past 3½ years, and almost 40% of all GIS breakers 115 kV and above for the U.S. utility industry. Our customers: Southern California Edison and Pennsylvania Power and Light.

HVDC—You'd expect us to lead the pack, and our success lives up to your expectations. The three HVDC projects we've completed in the last 18 months (between Vermont Electric Power Company and Hydro-Quebec; Bonneville Power Administration and Los Angeles Department of Water and Power; and Intermountain Power Agency and LADWP) total 2,200 Mw, almost twice as much as our nearest three (yes, three) competitors combined.

$450 million worth of promises kept.

Here's a project-by-project description of how we went from nowhere to number one in the U.S. transmission system business in the last few years.

CUSTOMER	PROJECT NAME/SIZE	KEY POINTS
Static Var Systems Kansas Gas & Electric Company	Murray Gill Substation —25 to + 200 Mvar (138 kV) Gordon Evans Substation 0 to + 300 Mvar (138 kV)	–Turnkey project –Includes technology proven at AEP Beaver Creek
Hydro-Quebec	Chibougamau, Quebec 2 x (—115 to + 330 Mvar) (735 kV)	–Turnkey project
Hydro-Quebec	La Verendrye, Quebec 2 x (—115 to + 330 Mvar) (735 kV)	–Turnkey project
Series Compensation Systems Pacific Gas & Electric	Tesla Substation 600 Mvar (500 kV) Table Mountain Substation 600 Mvar (500 kV)	–Short delivery requirements –Largest zinc oxide protected systems in world –Advanced seismic design
San Diego Gas & Electric	Imperial Valley Substation 2 x 150 Mvar (500 kV)	–Advanced seismic and electrical design
HVDC Systems Los Angeles Department of Water & Power (LADWP) Intermountain Power Agency	Intermountain Power Project 1600 MW + 500 kV 496 miles	–Built to equal nuclear plant standards –Turnkey project
Bonneville Power Admin. LADWP	Pacific Intertie Upgrade 2000 MW + 500 kV 846 miles	–Accepted 2 weeks ahead of schedule –New generation control technology
Vermont Electric Power Company Hydro-Quebec	Highgate 200 MW + 56 kV Back-to-back	–Turnkey project –World's fastest completion: 17 months
GIS Systems Southern California Edison	Serrano Substation 500 230 kV	–Advanced seismic design
Southern California Edison	Valley Substation 500 115 kV	–Turnkey project
Pennsylvania Power & Light	Sunbury Substation 550 kV Wescosville Substation 550 kV	–First 500kV GIS stations in U.S. by European supplier

To find out more about our systems and our promises, contact Dave Brucker, ASEA Power Systems, 66 Bovet Road, San Mateo, CA 94402. (415) 574-5400.

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Changing technology for changing times.

monopoly power if unconstrained by regulation. Today, managers don't see much of this vaunted monopoly power—rather, managers see intense competition with competing fuels and economic and political constraints of all sorts, with or without regulation. As a practical matter, to most utility managers, the existing marketplace already looks pretty "competitive" in the colloquial, if not in the technical, economic use of the term.

Today's strategic planners need to cultivate this "inside-outside" managerial perspective on competition. Tables 1 and 2 make the distinction. In Table 1, competition is an economic matter. Note the key attributes of a competitive versus a regulated market as seen from an economist's outsider perspective: competition, not regulation, sets prices; it allows unrestricted entry and exit from the marketplace; it encourages the pursuit of economic efficiency versus political equity objectives. And to an economist, competition means attention to marginal costs, not the average embedded costs which regulators find so important.

This view is fine, but compare it with Table 2, which contrasts competition with regulation from a manager's insider perspective. The key issues here are not matters of price setting, entry, or equity, but matters involving the internal organization of the utility and the relationship of the organization to its economic constituents—matters that ought to be the object of strategic planning.

Competition and Organizational Focus

For example, under regulation, management tends to focus its corporate attention on issues of supply, in part because product characteristics and prices are administratively determined, but also in part because, under regulation, the profits generated by demand expansion often go to ratepayers in the form of lower prices and not to shareholders. Competition, in contrast, necessitates an organizational focus on demand, first because the fruits of demand expansion can now accrue to stockholders, but also because management's focus on a particular market segment is a classic method for achieving success in a competitive market.

AT&T, before the breakup, recognized the critical need for marketing skills in a competitive environment. But after the breakup, AT&T realized that the intellectual recognition of the need for marketing skills is not the same as the creation of these skills organizationally. Strategic planning can help management avoid this pitfall only if planning begins to focus on internal organizational and human resource issues as well as on the traditional economic and technical issues that it now tends to address with such sophistication.

Table 1

Regulation Versus Competition: The Economist's Outside Perspective

Regulation	Competition
Administered Prices	Market-Set Prices
Controlled Entry and Exit	Free Entry and Exit
Social Objectives	Efficiency Objectives
Historical Costs Matter	Marginal Costs Matter

Table 2

Regulation Versus Competition: The Manager's Inside Perspective

Regulation	Competition
Focus on Supply Side	Focus on Demand Side
Product Administratively Determined	Product Market-Determined
Homogeneity Desirable	Differentiation Essential
Absolute Level of Cost Important	Relative Cost Important
Politics Primarily Administrative	Politics in All Arenas, Especially Media and Legislative
Stability a Goal	Flexibility a Goal
Reactive	Proactive

Competition and Look-Alike Utilities

In a regulated environment, it is often desirable for one utility to look much like another. It makes the regulator's task more manageable and tends to coincide with the political realities of regulation. The challenge of competition is to differentiate one company from the other. Indeed, the rule from economic theory is that profits are reduced to a minimum in a competitive market when all producers look alike. Competitors can only realize extraordinary results by differentiation—either with regard to market segment orientation, product attributes, or cost.

Cost differentiation in the market for electricity is easy to understand: lower costs are an obvious source of competitive advantage. But product differentiation in the electricity market is a little tougher to envision. Yes, it is possible to think of a utility that specializes in generation or distribution, but to think of ways to differentiate service levels, product offerings, and the like is clearly the more serious challenge posed by competition.

Strategic planning can play an important role in helping management cope with the differentiation challenge, but it can only do so if planners begin to focus their attention and methodologies on marketing questions.

Competition and Embedded Costs

In regulated markets, the absolute level of historical embedded costs is critically important. Today, many utility planners expend a good deal of effort analyzing these embedded costs—for example, to determine the adequacy and timing of depreciation recovery. The intellectual challenges of such endeavors and the practical significance under current institutional circumstances notwithstanding, the fact is that such efforts divert planners from grappling with questions of relative costs, incremental costs, and corporate competitiveness. These are the questions that are important under competition. General Motors cannot look at its depreciation accounting practices and then turn to customers and say, "You should pay more so we can recover our money sooner." GM can play this game with the Internal Revenue Service, but the market will pay what the market will pay, not what GM would like—or even ought—to receive.

Planners will only be able to serve management's needs well in the newly competitive environment in which utilities find themselves if they are at least freed from exercises in regulatory accounting to pursue issues involving true competitive economic imperatives.

Competition and Stability

In a regulated setting, stability is often an implicit if not an explicit organizational goal. In a competitive environment, organizational stability typically must give way to the need for organizational flexibility. Competition is an ongoing process of differentiation. Success in competitive markets is always temporary because success means profits, and profits mean the entry of competitors who, in the pursuit of their own profits, reduce them for everyone. (That's why economists like competition in the first place!)

Now the development of a flexible organization is no easy managerial matter in any setting, but it is a particularly difficult matter in the electricity industry. Being flexible

Michael Philip Manheim, Photo, Inc.

Above: Product differentiation will be harder to achieve than cost differentiation.

Right: The questions of relative costs, incremental costs, and corporate competitiveness must be answered.

means changing the conventional ways of managing a utility, with implications for career development, compensation, and labor relations. (Look at TWA or AT&T and their labor relations problems following deregulation.)

In order for strategic planners to help management deal with this challenge, they must pay far more attention to matters internal to the organization of utilities than they typically do at present. This requires new skills in organization design, innovation, and human resource management.

Competition and Politics

As Table 2 shows, one of the principal differences between regulated

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Ken Sherman, Unphoto

Above: The new game will require a new kind of political savvy.

and competitive markets is the way in which political forces play themselves out. In a regulated market, political forces are intense, but they are typically directed through rather formal administrative channels. Now these procedures do not always work as well in practice as they do on paper, and they are often quite cumbersome, but the fact is that these procedures are relatively familiar. Accordingly, there has not been much advantage to be gained by devoting planning resources to formal political analysis.

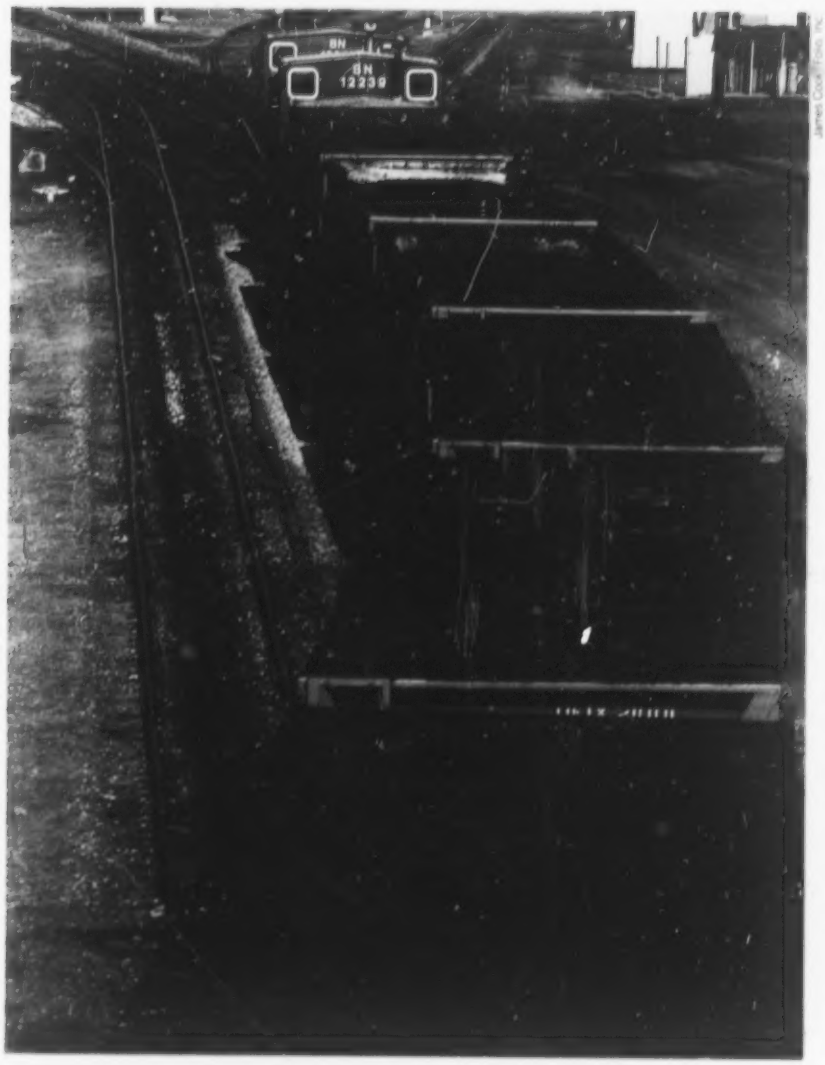
Competition, however, fundamentally changes the way in which the political forces in this industry will manifest themselves. While it is difficult to predict just what these differences will be, they will almost certainly expand the role of media and legislative politics, and they will require managers to develop a new political sophistication.

Facing the politics of a competitive environment, utility planners and managers start even: neither has the advantage of experience. In such a setting it is reasonable to ask strategic planners to apply their considerable analytical and intellectual skills to matters of politics. This is not to advocate the politicization of the planning function, but rather to suggest that planning must now include in its bag of tricks the ability to conduct political as well as economic analyses if planning is to serve management well in a competitive environment.

Table 3

Dos and Don'ts of Strategic Planning in a Competitive Environment

1. Don't abandon existing planning techniques.
2. Don't resist methodological change.
3. Do develop new marketing models.
4. Don't confuse sophistication with complexity.
5. Do develop new models of political behavior.



James Cook/Photo, Inc.

Variations in fuel prices from one company to another can bring profit or bankruptcy.

This last point merely serves to reemphasize one of the most critical traits of a competitive market for electricity. Competition really will change the way a utility must operate—not only when dealing with the external marketplace, but when dealing within its own organization. In a regulated environment, to spend planning money on political matters would likely be outright dysfunctional—it's hard to envision many public utility commissions passing these costs along to consumers. In a competitive environment, such a resource commitment may be essential.

Dos and Don'ts

Because competition brings a fundamental change in the way of doing business, it demands fundamental change in the way we conduct strategic planning. Table 3 provides a short list of "dos and don'ts" for strategic planners trying to cope with the new demands of competition.

1. Don't abandon existing planning techniques.

Because competition is so different from regulation, there may be a temptation to believe that a wholesale change in planning perspective is necessary. That need not be the case. Many of the planning tools in current use can easily be adapted to the analysis of competitive market conditions. For example, complex load growth models and generation models have been developed at great expense; they are highly sophisticated, and their equivalent would be the envy of many strategic planners in already competitive sectors of the nation's economy. These models may require some modification to meet

Ronald William May

In a regulated market, political forces are formally organized: public hearings, due process, consumer representation, etc. In a competitive market, these trappings are gone, but not the political pressures.

competitive realities, but planning instruments should not be abandoned, only improved. This might mean adding some simultaneity to models that may now operate sequentially, or it may require making a variable or two endogenous that are now treated exogenously.

2. Don't resist methodological change. If it is true that old tools should not be abandoned, it is also true that new ones should not be resisted. Managers of the strategic planning function need to be aware that many artisans—and strategic planning is an art—resist the introduction of new tools. In the 1960s, your TV repairman likely told you that integrated circuitry was a step backward because it made TVs hard to fix. In fact, it made them less prone to break and easier to fix—but it did require that even the experienced and skilled repair people change their ways. In the 1970s, your auto mechanic told you that all those onboard computers made it impossible to tune your car properly. Again, these technical changes made it easier to tune your car—but only for the properly trained mechanic.

Competition in the electric utility industry is not much different. We can analyze competition using old tools designed for the old regulatory "technology." If we do, we may sometimes erroneously conclude that the new competitive technology is a step backward. New tools and analytical perspectives designed for the new circumstances might well yield a different conclusion; hence, it is important that strategic planners not resist change in the methodologies they employ.

3. Do develop new marketing models. Planners should not merely not resist methodological change; they should actively encourage it. For example, at present, because the market for electricity is regulated, utility managers typically deal with their customers through the intermediary of a regulatory commission. The bundle of goods and services we now simply call "electricity" is largely determined by the exercise of administrative procedures, not consumer discretion. One of the lessons from the deregulation of other previously administered markets has been the tendency to unbundle goods and services. Thus, in telecommunications, dial tone was separated from the equipment and both were separated from long-distance service. In the new and highly competitive cellular phone business, unbundling has advanced to the point of offering customers a choice as to the probabilities that they will actually receive a dial tone instead of a busy signal when they pick up the phone. Historically, such questions of service reliability were strictly the domain of the regulatory process.

In air transportation, some airlines now fly with "no frills" and others fly with only frills. Similar unbundling and rebundling is occurring in the natural gas industry as transportation is separated from supply.

Indeed, such forces have been at work in the electricity industry for years as distribution and generation have been decoupled.

Planning can no longer merely react to these types of changes from the regulatory process, but must anticipate them in order to achieve competitive success. In-

Pierre Kopp/ West Light

Today's strategist must welcome competition as an opportunity for the company, not a problem.

deed, planners must actively seek them out. This will require new data, new methods, and new analytical perspectives. Perhaps the most pressing challenge to strategic planners in the utility industry today is to develop the tools necessary for analyzing the attractiveness of various unbundling schemes.

The development of these tools may well require utility management to go relatively far afield. It is interesting to note, for example, that when Apple Computer decided to shift from a technical to a consumer marketing orientation, it chose John Sculley, then president of Pepsi Cola, to head the company. It's tough to think of two markets farther afield than computers and soft drinks!

4. Don't confuse sophistication with complexity.

The key distinction is not between complexity and simplicity, but between complexity and sophistication. Sophisticated planning requires analytical techniques tailored to the questions being addressed. The questions are simply different in regulated and competitive markets as Exhibits 1 and 2 show. Complexity is a secondary factor. Indeed, the most sophisticated models are often the simplest. (Good models are a bit like good memos: a one-page memo is always tougher to write—and is more useful to management—than a 50-page memo.)

5. Do develop new models of political behavior.

If planners must develop new models to deal with management's concerns in a competitive environment, they must also develop new models that deal explicitly with the changes that competition brings to the political environment in which utilities must operate.

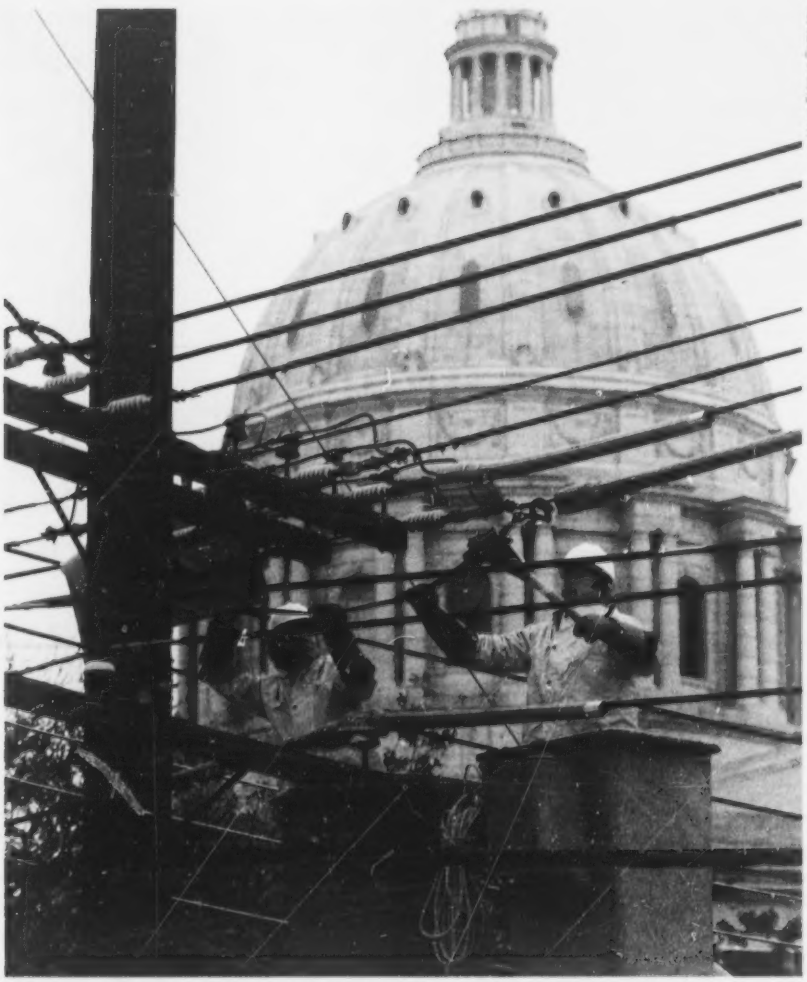
There is a natural tendency to think of a regulated industry as highly political and a competitive industry as apolitical. In fact, however, no industry is apolitical—industries merely vary in the manner in which political forces *are brought to bear.*

Indeed, while economists champion competition as a "market force," perhaps the biggest consequence of the introduction of competition into the electricity marketplace will be political: the terms and procedures for introducing political pressures will be different. Thus, in a regulated market, political forces tend to be organized in a formal manner: public hearings, due process, consumer representation, etc. In a competitive market, these institutional trappings are often missing, but not the political pressures. The result is that the pressures tend to get played out in different ways.

When competition enters the marketplace, the terms of political interaction change. Strategic planners, if they are to serve management effectively, can no longer remain apart from politics, but must apply the same analytical rigor to political forces that they now apply to economic forces.

Hard Thinking

Developing effective strategic planning in the electric utility industry today is a costly undertaking. Data are expensive to collect, process, and analyze. Scarce professional talent is engaged in an activity that ought to be absolutely



Union Electric Company

Utilities must rethink their approach to politics, marketing, organizational design, and human resources management.

central to the future of the industry. Yet as this industry confronts the challenges of competition and regulatory change, the strategic planning function, if it has existed at all, has somehow ceased to be strategic, but instead has been caught up in the day-to-day business of operating in a regulated environment with little or no competition.

But if it is true that planning must have day-to-day relevance, it is also true that strategic planning's ultimate rationale is not to serve the corporation on a daily basis, but to provide management with a source of information, analysis, and ideas that challenge the current ways of doing business and lead the enterprise into the future.

Some may argue that competition is not in the future of the utility industry. Others would argue it is already here and encroaching rapidly on more and more traditionally regulated functions. Certainly the experience of other regulated industries—from telecommunications and trucking to prisons and the post office—should make a strategist in this industry think hard about the prospects for competition in electricity.

To conduct this hard thinking, we need effective strategic planning. To be effective, today's planners need to develop new perspectives on *marketing, organizational design, human resource management,*

Cartoon Features Syndicate

"He doesn't chase cars, but he keeps them under constant surveillance."

and *politics.* Strategic planners must be motivated by the need to turn environmental change of the type competition represents into an opportunity for the enterprise, not a problem to be overcome.

Back to the Dog and the Car

Strategic planners need not ask what they will do with the car because they don't need to catch it. They need to devote their attention to understanding the organizational skills they must have and the means they will use for the chase in the first place. Competition, like the chasing of cars, is a process, not an outcome. The benefits come from its pursuit, not its attainment.

Just a Thought

Instead of asking what the dog will do once it catches the car, planners ought to ask how they might hook up that dog to a generator. . . .

Nuclear training instructors are top-notch.

Great Strides in Nuclear Training

Performance-based, accredited training programs reach for the ultimate in safety and reliability.

One positive thing that came from the Three Mile Island (TMI) accident was new insight into the unique demands on the control room crew in a nuclear power plant and the crucial importance of training.

Before TMI in 1979, there were training and licensing procedures for nuclear plant operators; however, training for the most part involved experienced operators passing on what they had learned about the job to new employees. Given the excellent safety record of the nuclear industry overall, even the most seasoned operator was limited in his or her experience—particularly when it came to confronting unusual and potentially threatening conditions like those that might precede a significant nuclear accident.

Utilities Take Charge

"The nuclear community agreed that it needed to take major, proactive measures to confront this situation," says Suzanne Phelps, director of nuclear activities at Edison Electric Institute. Industry professionals believed that proper recognition of the benefits of nuclear power would come only when the industry demonstrated that all its members were consistently managing and operating their facilities at or *above* an industry standard of acceptable performance that *exceeds* regulatory requirements. Such operations would not only meet all safety standards and goals, but would also enhance safe performance, improve reliability, and reduce the cost of producing electricity for utilities and their customers. The Utility Nuclear Power Oversight Committee summed up the challenge: "Quality of operational performance is the *sine qua non* for public acceptance and regulatory trust."

In late 1979, the industry took a major step toward securing that trust by establishing the Institute for Nuclear Power Operations (INPO), the mission of which is to ensure the safety and reliability of nuclear operations. To this end, one of its primary objectives and one of the industry's significant successes has been an extensive, industry-wide initiative to improve and sustain the training performance of all utilities operating nuclear power plants.

Enter the National Academy

With INPO's assistance, the nuclear industry took the next logical step in 1985 of creating the National Academy for Nuclear Training to focus and unify efforts at upgrading training for nuclear plant personnel. All U.S. electric utilities that operate or are building nuclear power plants are members of INPO and, therefore, are eligible to be members of the Academy. The Academy provides the framework to coordinate the various training activities. The director of INPO's Training and Education Division, a corporate vice president, serves as the Academy's executive director. In addition, a group of ten executives and senior managers from INPO member utilities make up the Academy Council, which provides an ongoing industry perspective on Academy operations. The Council meets regularly with the executive director to review Academy activities as well as all INPO training programs and activities.

As part of the Academy, INPO manages the industrywide program for the accreditation of training programs for key operations, maintenance, and technical support personnel in nuclear plants. Every nuclear utility has accepted this accreditation process and has committed to having its training efforts accredited in the ten central positions necessary for nuclear plant operations. Moreover, the Nuclear Regulatory Commission (NRC) has encouraged and formally endorsed this accreditation procedure.

As part of the accreditation process, the independent National Nuclear Accrediting Board determines whether a utility's training programs meet established industry standards. The Board is composed of 20 scholars and executives from four groups: senior utility management, non-nuclear industrial training, post-secondary education, and nominees from the NRC. When a plant's first training program is accredited, it becomes a branch of the Academy and is eligible to issue certificates to graduates of accredited programs. Accreditation of all training programs in the

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Mitch Kezar Unsplash

ten specific operations areas is a condition of full membership in the National Academy for Nuclear Training. The ten positions are:

- Nonlicensed operator,
- Reactor operator,
- Senior reactor operator/shift supervisor,
- Shift technical advisor,
- Instrument and control technician,
- Electrical maintenance personnel,
- Mechanical maintenance personnel,
- Chemistry technician,
- Radiological protection technician, and
- Technical staff and management.

Performance-Based Model

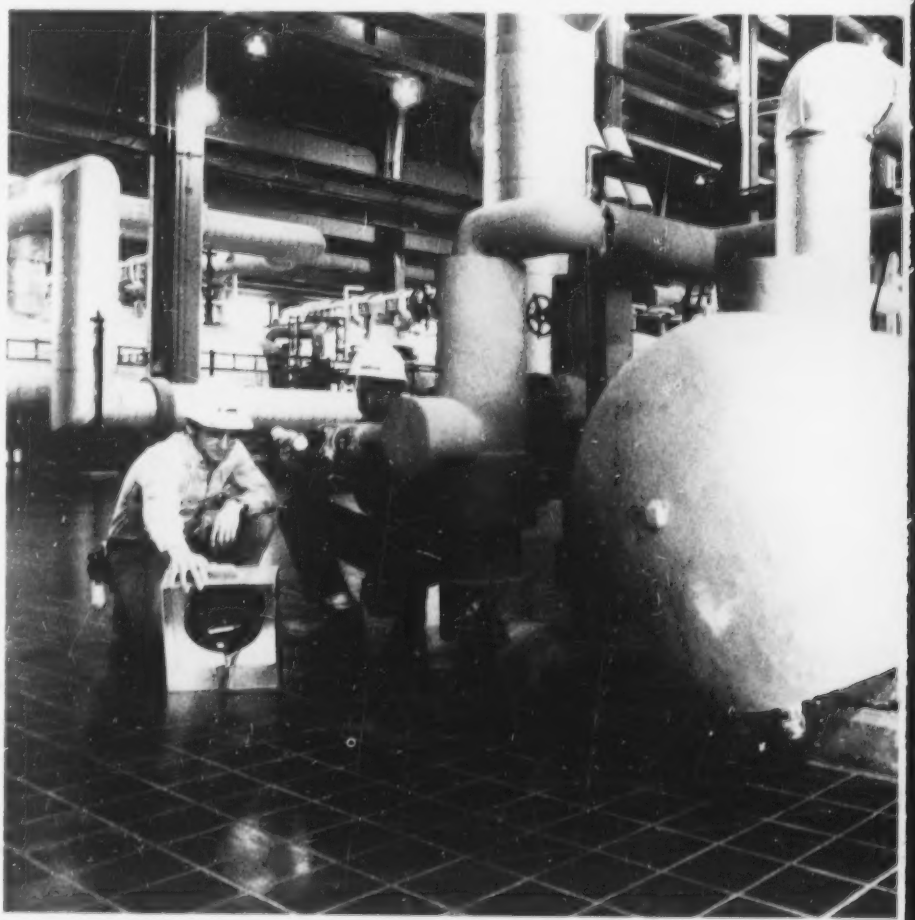
But accreditation and full Academy membership come only after solid commitment and hard work by participating utilities. Using a model with procedures established by INPO, a utility first must develop training programs with a systematic, performance-based approach. INPO's performance-based model reflects the state of the art in training design, with modern program and curriculum development incorporated into a training system development approach.

The performance-based model removes the former dependence on a theoretical idea of what is involved in nuclear plant operations or even on a limited experience base from veteran operators. The model requires doing an intensive, plant-specific analysis of *every* task demanded of a plant operator in all of the ten key positions in order to create a curriculum that addresses the actual needs of employees on the job. This means that a utility pursuing accreditation must go into its nuclear plant and, for each key job, conduct an exhaustive analysis of the knowledge and skills required to perform according to set standards. INPO has developed model competencies for each key position and maintains a computer data base of this information. However, the differences among nuclear plants mandate that the individual utility perform a thorough analysis of its own system. This ensures that employees can perform effectively not only within a generic or theoretical environment but also in the unique environment in which they will be carrying out their responsibilities.

Once the analysis is done, the utility's training staff designs training programs based on certain performance indicators and established performance criteria. Again, the goal is to remove any guesswork from the process and to tie the training directly to performance-based objectives.

Getting Accredited

After implementing its curriculum, the utility sends INPO a self-evaluation report documenting



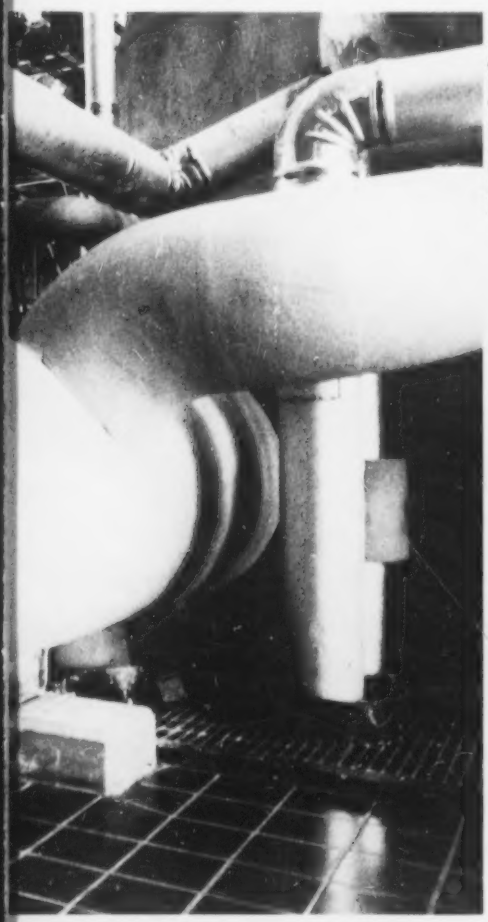
For each nuclear utility, the goal is accreditation of training programs for all ten key jobs.

how the training programs meet accreditation criteria. An accreditation team of training experts from INPO and utilities visits the plant, evaluates the training programs, and makes any corrective recommendations to the utility. This team's assessment, along with a report on the utility's corrective actions, is presented to the utility and the National Nuclear Accrediting Board.

A working group of five members of the Accrediting Board meets to consider accreditation for each nuclear plant's training programs. This working board includes one or more individuals from each of the four classifications noted above. However, a majority of representatives must come from outside the nuclear industry to ensure that the board is independent of the utility industry in its decision making. Finally, the utility makes a formal presentation on its training programs before the board, and the board makes its decision to award or defer accreditation.

The accreditation process is the backbone of the National Academy for Nuclear Training. The process ensures the quality training needed to support safe and reliable nuclear plant operations and gives the industry a focus for its training goals. The process also involves a renewal of accreditation every four years to ensure sustained quality and improved performance across the industry. To get and keep accreditation, a utility's training program must include an effective, ongoing effort to identify and implement changes as needed.

INPO sponsors a number of other related programs and activities. Technical assistance covering virtually all aspects of training is provided to utilities on request, and INPO regularly holds workshops and seminars for utility training staffs. In addition, INPO

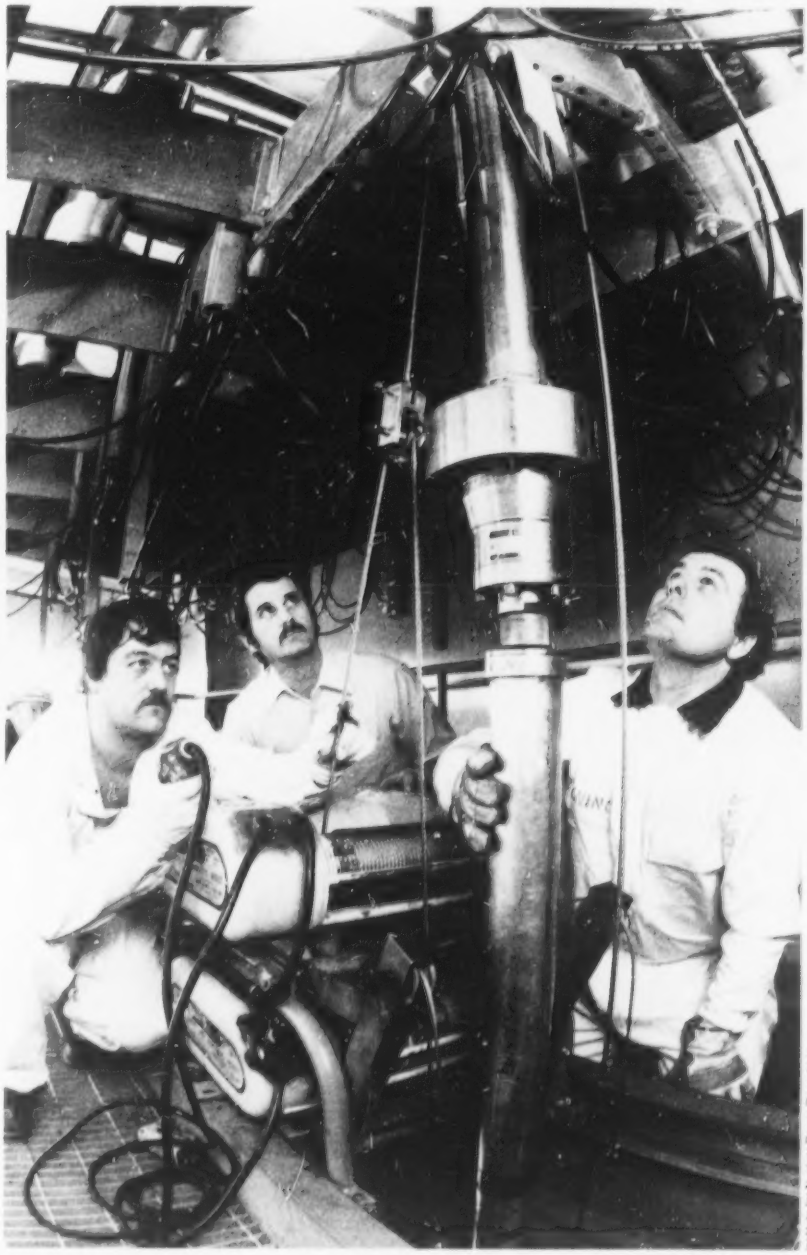


Institute for Nuclear Power Operations

Institute for Nuclear Power Operations

Institute for Nuclear Power Operations

Specially designed training centers are now the norm. Overall, utilities average 45,000 square feet of space devoted to training nuclear workers.



Institute for Nuclear Power Operations

evaluates each nuclear plant in the nation on a regular basis, examining both the training itself and the results of training—how workers actually perform on the job. By focusing on how workers apply their knowledge and skills in the plant, these evaluations give INPO and the Academy independent feedback on the quality of training and the quality of graduates from accredited programs.

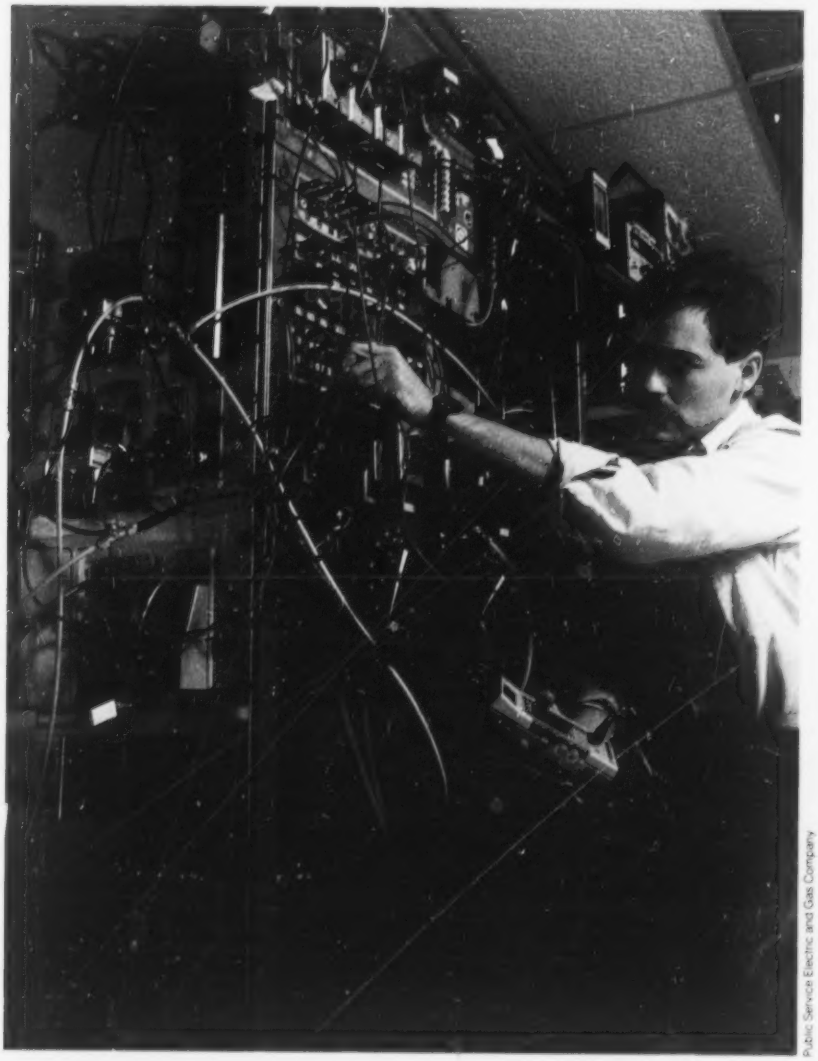
New World of Training

The electric utility industry's redoubled concentration on quality in nuclear training has brought a radical change to the most visible parts of the picture.

Ten years ago, nuclear trainers were often fighting for borrowed instruction space at nuclear power plants. Today, training has emerged from cramped quarters and set up shop in specially designed training centers. Systematic program development, well-equipped labs, computer-based instruction, and the latest in training aids and tools are the norm. Each utility has an average of over 45,000 square feet of space—and the industry as a whole has more than 2.3 million square feet—dedicated exclusively to training nuclear workers; this is five times the amount in use seven years ago and almost 50 percent more than two years ago.

In 1979, there were ten training simulators in the industry. Currently, there are 52 of these multi-million-dollar machines in operation, and, when those planned or under construction are complete, 75 will be in use.

The size of the training staff has increased just as dramatically. Ten years ago, a typical nuclear plant had one training coordinator and a handful of instructors. Today, an



Public Service Electric and Gas Company

At PSE&G's Salem nuclear plant, analyzing individual jobs is the building block for performance-based training programs.

average of 32 instructors and 16 additional training professionals are at work.

In 1985, more than 6,000 people completed formal, initial training programs for the ten key nuclear plant positions. This is twice the number completing similar programs in 1982 and 38 percent more than two years earlier.

Between March 1984 and January 1986, the total number of nuclear training positions increased by 69 percent, from 2,781 to 4,707. As a group, managers and supervisors average 14 years of nuclear training and nuclear plant experience.

These are all examples of the strides the industry has made in upgrading training for nuclear power plant personnel. Responding to the need to establish the highest levels of safety and reliability in nuclear plant operations, the industry has built sophisticated facilities, developed highly qualified training staffs, and created top-notch programs to train workers. Above all, the industry has established a framework to ensure that this level of quality is consistent, across-the-board, and enduring.

WHAT FOUR COMPANIES HAVE DONE

by Mark Reynolds

Steve Jones is the general supervisor for nuclear training with Baltimore Gas and Electric Company (BG&E), based in Baltimore, Maryland. He admits that his company "had never looked that closely at operator training" before Three Mile Island (TMI). "Prior to 1979, our training staff was composed largely of experienced operators who based their instruction on their individual knowledge of the plant. Our Calvert Cliffs nuclear plant in Lusby had been on-line since 1974, but our training program was reactive rather than proactive—we responded to problems and issues as they emerged."

Denis Hanson, manager of nuclear training at Public Service Electric and Gas Company (PSE&G), headquartered in Newark, New Jersey, describes a similar approach during the early operation of the nuclear plant in Salem. "It was a loosely structured process with contractors and experienced operators training new operators. There was no formalized approach to assure that industry experience or that the kinds of changes that occur over time were routinely addressed in the training."

TMI changed things considerably. In the wake of the TMI accident, both BG&E and PSE&G, as well as most companies that operate nuclear power plants, began a comprehensive overhaul of their nuclear training programs. And the performance-based model designed by INPO has become the standard for the industry.

The first step in redesigning training involved an extensive analysis of individual job responsibilities. The objective was to detail

Union Electric Company

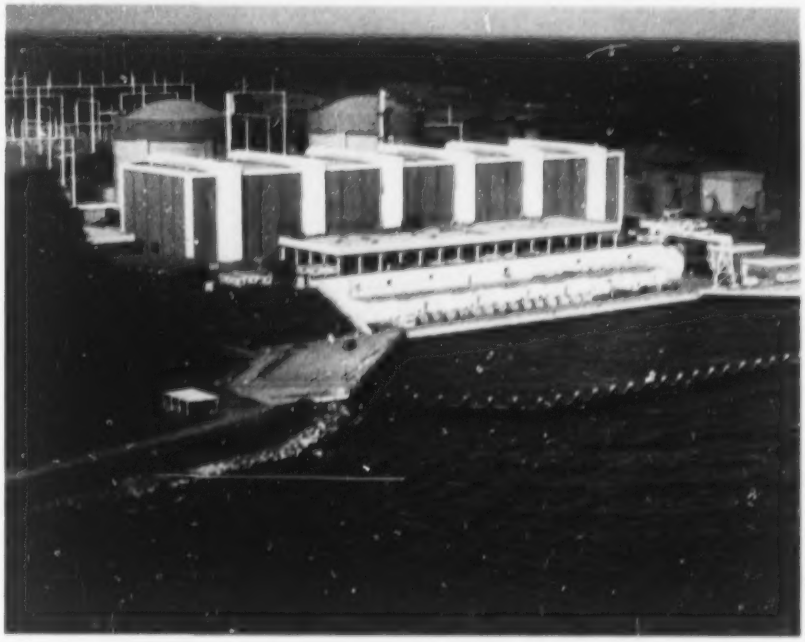
Multi-million-dollar simulator at Union Electric's Callaway plant can create a wealth of normal and abnormal conditions to test trainees.

every specific responsibility of a nuclear plant operator and to identify the knowledge and skills required to fulfill those responsibilities efficiently, effectively, and safely. Jones explains, "We analyzed all job duties, looking at each individual task, asking how often it was required, how difficult it was, how critical to plant operations, etc., to come up with a genuine understanding of exactly what is involved in the plant operator's performance."

The results of the analysis then were translated into a formal, performance-based training program, with a structure for evaluation based on detailed and plant-specific task descriptions. Hanson describes this as a "process of working backwards: looking at the job to see what is involved, then stepping back to examine how best to address the requirements of the job in a training environment, and then stepping back again to decide what qualities or skills employees should have before even beginning the operator training."

The process of working backwards has proved a major step forward for the industry. The impact on overall plant operations has been "tremendous," Jones believes, largely because the training is rooted in actual performance. "The basis of all training is what the individual needs to know to perform his or her job, to perform it well and under a variety of circumstances." Hanson notes that the analysis of performance "put the training more solidly in touch with the actual demands of the job and needs of operators."

Richard Coe is director of training and education at GPU Nuclear Corporation in Parsippany, New Jersey, the company that operates the TMI plant in Middletown, Pennsylvania, and the Oyster Creek plant in Forked River, New Jersey. He agrees that the current training initiatives throughout the industry reflect a new performance-based philosophy that is making a demonstrable difference in the safety and efficiency of nuclear plant operations. "The knowledge,



Baltimore Gas and Electric Company

At BG&E's Calvert Cliffs nuclear plant, all instructors must stand an eight-hour watch every month.

the technology surrounding nuclear power—these things exist; it's not a new or untested science, but a real discipline. We know, for example, that nuclear plants react in certain predictable ways under given sets of conditions. By training our plant operators to treat the symptoms of problems as they occur, they can move through a rapid, logical progression of steps to identify the cause. At the same time, they will be containing the problem itself. To prepare nuclear plant operators successfully, we need to give them both the big picture of *how* things happen within a reactor and the specific skills to control, adjust, and respond effectively."

The process for achieving this expertise is extensive. At GPU, aspiring qualified candidates undertake one and a half years of full-time training before they qualify to take the Nuclear Regulatory Commission (NRC) test for a reactor operator license—and several more years of training before qualifying as senior reactor operators. While the training program still involves some traditional classroom settings, the major emphasis throughout the industry is on plant-specific, simulator, and on-the-job, hands-on training.

At Union Electric Company in St. Louis, Missouri, for example, nuclear operator trainees receive a two-inch stack of Qualification Cards detailing the various tasks involved in their future jobs. Each trainee must go into the plant and, working with an experienced operator, perform the specific task outlined on each card. John Price, su-

Robert Eske Public Service Electric and Gas Company

PSE&G's simulator training at Salem is rigorous: it's no two- or three-week vocational education course.

perintendent of training at the Callaway plant in Fulton, underscores the value in having the trainee actually perform the task under the specific conditions of the plant and using the exact materials available on the job: "It's the best way to know for certain that the person can do the job."

One gauge of the industry's commitment to plant-specific, performance-based training is the millions of dollars companies are spending to acquire simulators. Designed to recreate the actual conditions of an individual plant's control room, simulators have played a dramatic role in improving operator training. As GPU's Coe explains, "The simulator allows us to create any set of potential conditions that might arise within the nuclear plant. Operators can go through startups, heatups, and changing power levels. They can monitor plant responses such as the build up and decay of xenon in the reactor as the power fluctuates or watch levels of neutron flux in the reactor core as the control rods move in and out."

Most importantly, the simulators also can create unusual and extreme plant conditions, like a major loss-of-coolant accident—something all companies hope that their operators will never have to experience for real. "The objective is to have our plant operators become so familiar with the plant's operation that the abnormal becomes normal—and we are never again put in a situation of seeing a problem for the first time," Coe explains.

The simulations during training are so effective that those taking part frequently forget that they are in a test situation. Coe says that "it's not unusual to see sweat marks on the backs of shirts during a simulated accident—it's that real." Hanson recalls an experience during a simulation when one of the trainees rushed over, grabbed the phone, and started swearing when he couldn't contact one of the plant support departments that wasn't included in the simulated phone system. "The simulation is so effective that they forget it's not the real thing. The impact on job performance with this kind of training experience has been incredible."

In addition to the control room simulator, GPU has designed and added what they call the Basic Principles Training Simulator (BPTS). Coe describes this as a "conceptual" training instrument, unique to GPU's training program. It is designed to show *why* things happen within a plant, complementing the control room replica simulator which demonstrates *how* things happen. With the BPTS, trainees watch a visual display of plant systems' interactions and behaviors. More than 30 plant conditions can be simulated, and video screens on the console reflect plant parameters such as cooling, water levels, heat buildup and pressure.

The availability of equipment of this caliber as part of the training program reflects the nuclear industry's commitment to safety and efficiency. As PSE&G's Hanson explains, "This is research-level equipment applied with a highly structured training program that is intensive, specialized, and rigorous. This is not some two- or three-week vocational education project." PSE&G has received INPO accreditation in all ten major job areas. In addition, nuclear plant personnel in PSE&G's training program recently began receiving academic credit that can be applied to undergraduate and graduate degrees in nuclear engineering and related fields.

An operator's training does not stop once he or she passes the NRC licensing examination. Training is an ongoing process, and the NRC relicenses operators every two years. At PSE&G, operators are in training at least two months a year in order to maintain skills and proficiency levels. At GPU, where there are six shifts of operators for

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Robert Rardolph Unphoto

GPU Nuclear operates the Three Mile Island (above) and Oyster Creek nuclear plants. In the company's training program, a simulated emergency may seem so real that trainees break out in sweat while they work through the problem-solving steps.

each nuclear plant, one crew is always involved in full-time training. At Union Electric, one week out of every five, plant operators are back in training.

Instructors of NRC licensed personnel are themselves licensed. In addition, they must achieve and maintain an equally demanding instructor certification program. After certification, instructors are evaluated regularly for technical and instructional competence in an ongoing program. At BG&E, all instructors are required to stand an eight-hour watch in the plant every month. This ensures that they maintain their proficiency in plant operations and gives them first-hand knowledge of current issues and problems on the job. The regular time in the plant also allows the instructors to build rapport with the operators whom they will be training and to gain a personal perspective on their needs and concerns.

Union Electric was the third utility in the country to be fully accredited. Price describes the commitment of his company to training: "For over two years a staff of approximately 45 worked 40 percent overtime. We spent several million dollars to design and build a simulator. We have invested in two training facilities. Our current training program reflects an incredible investment of time, money, and staff resources. But it's paying off. The bottom line is that the plant operates more efficiently and productively than ever because the people responsible for that operation are better trained."

The bottom line at Union Electric and, indeed, the bottom line for America's energy future is a safe and stable supply of nuclear-generated electricity. The commitment that the industry has demonstrated toward training its nuclear operators is a clear signal of its commitment to that future.

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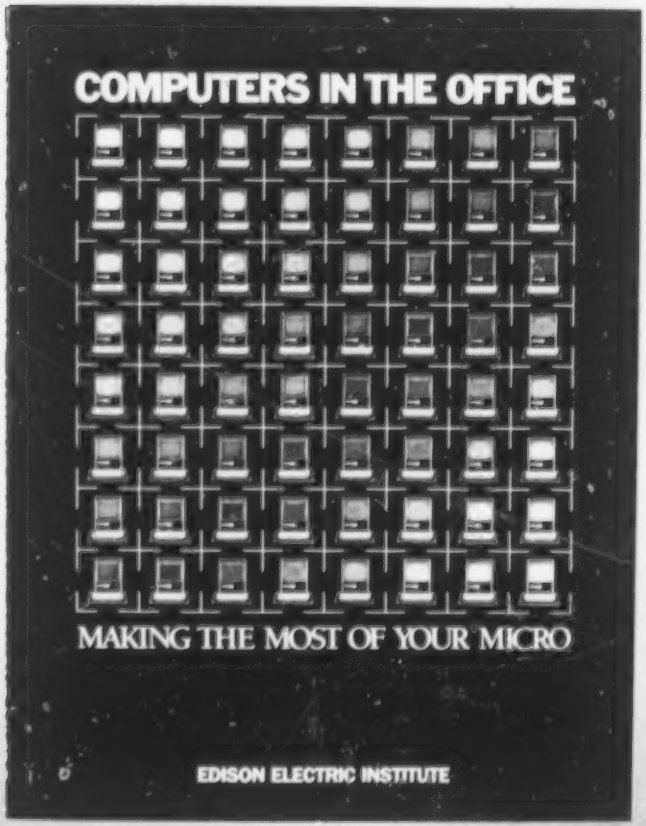

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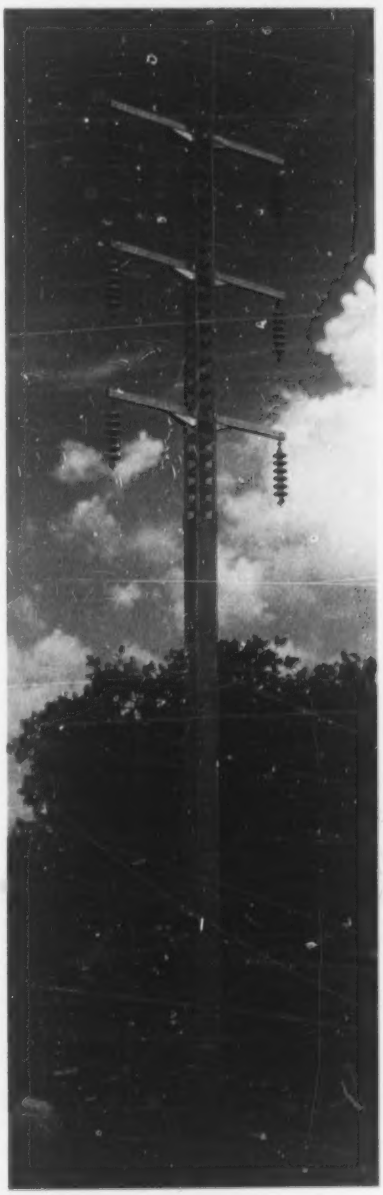

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FINANCIAL REVIEW

EARNINGS NEUTRAL; QUALITY OF EARNINGS IMPROVES AS AFUDC DECLINES

Per share earnings (before extraordinary items) for the investor-owned electric utility industry arrested the previous four quarters of decline by posting neutral earnings of 64 cents per share in the second quarter of 1986. This year's second quarter results repeated 1985 earnings of 64 cents a share (after adjustments were made for stock splits). Twelve-month earnings were $2.93 per share, off 5.8 percent from the $3.11 per share the industry earned during the twelve-month period ending June 30, 1985.

The reversal of the recent quarterly downtrend and the improvement over last year's annual per share earnings can be attributed to a 3.8 percent increase in electric operating revenues, a 12.2 percent decrease in fuel expense, a 13.5 percent increase in non-electric income, and rate relief. These were offset by a significant reduction in AFUDC, increases in depreciation and income tax expense, and an increase in the number of common shares outstanding.

The return on average common equity (ROE) (before extraordinary items) was 13.6 percent for the twelve-month period, compared to 14.5 percent for the twelve months ending June 30, 1985. The change in ROE was influenced by the increase in average common equity.

Extraordinary losses totaled $330 million in the second quarter of 1986 as one company's $353 million reserve for possible non-recovery of their investments in two nuclear projects was slightly offset by two companies' $23 million in extraordinary gains.

Earnings quality increased as the amount of AFUDC in net income declined. AFUDC as a percent of net income available for common was 42.8 percent in the second quarter of 1986, down from 54.5 percent one year earlier. During the twelve months ending June 30, 1986, AFUDC accounted for 41.4 percent of net income available for common, down from 48.5 percent one year earlier. Total AFUDC fell 16.2 percent from the second quarter of 1985 to the second quarter of 1986. The decrease in AFUDC is largely a result of the completion of several large construction projects within the past year. Additionally, AFUDC decreases have been caused by companies no longer accruing AFUDC on troubled or cancelled plants.

Total utility plant increased 13.1 percent to $264.5 billion from June 30, 1985, to June 30, 1986. CWIP (construction work in progress) dropped sharply as the $96.3 billion on record as of June 30, 1985, decreased 13.4 percent to $83.4 billion this past June. The drop in CWIP can be attributed to the completion of new plants and the disallowance/discontinuation of plants during the past twelve months.

The industry took advantage of relatively low interest rates to refund a whopping $7.4 billion in long-term debt in the first half of 1986, according to Ebasco Business Consulting Company. This is more than a sevenfold increase over the $963 million refunded last year. Lower interest rates allowed electric utilities to decrease the embedded cost of long-term debt from 10.1 percent during the second quarter of 1985 to 10.0 percent during the quarter ending June 30, 1986.

Both the quarterly and the twelve-month-ended, pre-tax interest coverage ratios improved over last year's second quarter (see table below), as pre-tax income increased at a faster rate than interest expense (with the exception of the year-ended ratio with AFUDC, which declined).

Pre-Tax Interest Coverage Ratios:

	Second Quarter		Year Ended June 30,	
	1986	1985	1986	1985
With AFUDC	2.83	2.79	3.06	3.09
Without AFUDC	2.42	2.27	2.60	2.53

The downward trend in industry fuel costs gained momentum in the second quarter of 1986 as fuel expense dipped 12.2 percent to $7.8 billion from $8.9 billion in 1985. This downtrend is caused by an increased utilization of nuclear generating capacity, a decline in fossil fuel costs, and increased usage of oil-fired units.

Tables 1 and 2 are based on unaudited reports submitted by a sample of investor-owned electric utilities. The sample is representative of approximately 94 percent of the industry's sales to ultimate customers and 93 percent of the industry's total assets. From this sample the data is then extrapolated to represent the entire investor-owned electric utility industry.

Contributed by the Finance Department of Edison Electric Institute.

Table 1
Investor-Owned Electric Utility Industry
Statement of Income
(Unaudited)
(Millions of Dollars)

	Three Months Ending June 30,			Twelve Months Ending June 30,		
	1986	1985	% Change	1986	1985	% Change
Total Electric Operating Revenues[1]	$30,239	$29,142	3.8	$125,941	$122,665	2.7
Electric Operating Expenses						
Fuel	$ 7,778	$ 8,854	(12.2)	$ 34,971	$ 37,718	(7.3)
Other Operation & Maintenance	8,687	7,900	10.0	33,221	31,264	6.3
Depreciation & Amortization	2,806	2,508	11.9	10,916	9,723	12.3
Taxes Other Than Income Taxes	2,291	2,133	7.4	9,151	8,718	5.0
Income Taxes: Federal & Other	934	744	25.5	5,808	4,921	18.0
Deferred Income Taxes	1,418	1,282	10.6	4,639	4,913	(5.6)
Investment Tax Credits, Net	387	421	(8.1)	1,935	1,887	2.5
Total Electric Operating Expenses	$24,301	$23,842	1.9	$100,641	$ 99,144	1.5
Electric Operating Income	$ 5,938	$ 5,300	12.0	$ 25,300	$ 23,521	7.6
Other Utility Operating Income	268	243	10.3	1,467	1,448	1.3
Total Utility Operating Income	$ 6,206	$ 5,543	12.0	$ 26,767	$ 24,969	7.2
Other Income & Deductions—Net	708	617	14.7	2,397	2,353	1.9
Allowance for Other Funds Used During Construction	1,071	1,243	(13.8)	4,682	5,254	(10.9)
Total Income Before Interest Charges	$ 7,985	$ 7,403	7.9	$ 33,846	$ 32,576	3.9
Interest Charges						
Interest on Long-Term Debt	$ 3,772	$ 3,554	6.1	$ 15,009	$ 14,310	4.9
Other Interest Expenses & Charges	223	246	(9.3)	975	1,127	(13.5)
Allowance for Borrowed Funds Used During Construction	(595)	(745)	(20.1)	(2,604)	(3,191)	(18.4)
Net Interest Expenses & Charges	$ 3,400	$ 3,055	11.3	$ 13,380	$ 12,246	9.3
Net Income Before Extraordinary Items	$ 4,585	$ 4,348	5.5	$ 20,466	$ 20,330	0.7
Extraordinary Items	(330)	(1)	N.M.	(1,997)	(55)	N.M.
Net Income	$ 4,255	$ 4,347	(2.1)	$ 18,469	$ 20,275	(8.9)
Preferred Dividends Declared	695	701	(0.9)	2,864	2,900	(1.2)
Net Income Available for Common	$ 3,560	$ 3,646	(2.4)	$ 15,605	$ 17,375	(10.2)
Common Dividends Declared	2,991	2,967	0.8	11,894	11,585	2.7
Additions to Retained Earnings	$ 569	$ 679	(16.2)	$ 3,711	$ 5,790	(35.9)
Average Shares Outstanding	6,090	5,681	7.2	6,015	5,606	7.3
Earnings Per Share Before Extraordinary Items[2]	$ 0.64	$ 0.64	0.0	$ 2.93	$ 3.11	(5.8)
Earnings Per Share After Extraordinary Items[2]	$ 0.58	$ 0.64	(5.1)	$ 2.59	$ 3.10	(16.5)
Common Dividends Per Share[2]	$ 0.49	$ 0.52	(5.8)	$ 1.98	$ 2.07	(4.3)

NOTES:
[1]Revenues are adjusted for intra-industry sales for resale of electricity.
[2]Based on average shares outstanding as reported to EEI by survey respondents and adjusted for stock splits.
N.M.—Not Meaningful

Table 2
Investor-Owned Electric Utility Industry Balance Sheet
(Unaudited)
(Millions of Dollars)

Assets	June 30, 1986	June 30, 1985	% Change
Utility Plant*			
Utility Plant (Including Nuclear Fuel)	$363,501	$323,454	12.4
Less Accumulated Depreciation	98,979	89,630	10.4
Total	$264,522	$233,824	13.1
Construction Work in Progress	83,414	96,299	(13.4)
Net Utility Plant	$347,936	$330,053	5.4
Investments	9,085	7,974	13.9
Current Assets	36,706	35,642	3.0
Deferred Debits	19,741	18,976	4.0
Total Assets	$413,468	$392,645	5.3
Capitalization & Liabilities			
Capitalization			
Common Stock	$ 86,762	$ 82,563	5.1
Retained Earnings	46,482	43,668	6.4
Preferred Stock	30,609	31,880	(4.0)
Long-Term Debt	153,227	146,313	4.7
Total Capitalization	$317,080	$304,424	4.2
Current Liabilities			
Short-Term Debt	$ 5,731	$ 6,212	(7.7)
Long-Term Debt Due Currently	4,818	3,811	26.4
Other Current Liabilities	26,745	26,055	2.6
Total Current Liabilities	$ 37,294	$ 36,078	3.4
Deferred Credits			
Accumulated Deferred Income Taxes	$ 34,297	$ 30,106	13.9
Accumulated Deferred Investment Tax Credits	16,379	14,858	10.2
Other Deferred Credits	8,418	7,179	17.3
Total Deferred Credits	$ 59,094	$ 52,143	13.3
Total Capitalization & Liabilities	$413,468	$392,645	5.3

*Includes non-electric utility plant.

TECHNOLOGY REVIEW

THE COMING BREAKTHROUGH: DISTRIBUTION AUTOMATION

One of the most significant technological innovations in the electric utility business during the *last* 20 years was the automation of bulk power system operations using digital computers and communications systems. The all digital "Energy Management Systems" installed during the late 1960s and 1970s gave system operators increased information about generating units, system interconnections, and bulk transmission systems. This increased information has made it possible to better control and coordinate bulk system operations and has provided system operators with the tools necessary to maintain high levels of system reliability while minimizing the cost of producing electricity.

In all probability, the automation of distribution system operations using digital computers and communications systems will be one of the most important technological breakthroughs during the *next* 20 years. Like energy management systems, distribution automation systems will give more information to operators and will enable electric utility companies to better control and coordinate operations in a "real-time" mode from remote locations. Distribution operators will be able to monitor information from sub-transmission and distribution substations and, in some cases, will even acquire readings from individual customer meters. Distribution automation will also make it possible to remotely control equipment and reconfigure systems from distribution dispatch offices, to connect and disconnect customer service, to implement load management actions, to optimize feeder loading, to control reactive power flows, or to automate service restoration.

Distribution automation systems will serve as more than tools for operators; they will also enable customers to receive timely and accurate information about available rates and choices that can be made. A distribution automation system with two-way data communications will make it technically possible for utility companies to implement rate structures that follow the cost of power. This will put customers in a position to save money by not using energy during "peak periods."

Experience with distribution automation systems will provide useful input to system planning and electrical design engineers. With much more data available concerning actual and specific conditions, models and generalized data will be obsolete; distribution systems will be designed to more effectively recognize differences in customer requirements, to reduce system losses, and to reduce maintenance and service restoration costs.

How soon will the advantages of distribution automation be realized? A number of electric utility companies have installed or are currently installing sub-systems of distribution automation systems or limited scale distribution automation systems. Different approaches reflect each individual utility's unique requirements and unique system characteristics. Some utility systems are starting distribution automation efforts to first meet system reconfiguration objectives, while others are initially focusing on remote meter reading benefits or load management opportunities.

The realization of full-scale distribution automation will require addressing a number of technical challenges. While the components for a distribution automation system are available as "off-the-shelf" technology, full-scale implementation will require the help of specialists and innovative techniques to integrate diverse components. In a given system, multiple telecommunications technologies may have to be used, electronic packages may have to be integrated with existing mechanical devices, information may have to be acquired from or replaced in existing computer data bases, and the procedures and operations of several utility departments may have to be modified.

The cost of the components and integration efforts to achieve full-scale distribution automation can be a major capital investment, and, in some systems, it may take longer to recoup the expense. However, the costs for computing power and telecommunications circuits are expected to decrease in the future. Nevertheless, as electric systems grow in dimension, become more structurally complex, and offer more customer service options, utilities will need the substantial control offered by distribution automation systems. EP

Contributed by the Engineering Department of Edison Electric Institute.

STATISTICAL REVIEW

THE COST OF HOUSEHOLD ELECTRICITY

As shown in Table 1, the average price of electricity consumed in residential service more than tripled from 1969 to 1985, rising from 2.09 to 7.38 cents per kilowatt-hour (kWh). Economies of scale and advances in boiler technologies pulled the price down steadily until 1969 when it reached an all-time low. Since then several factors—the growing number of environmental control requirements, unusually high rates of inflation, and more frequent construction delays—have pushed the price back up to match the 1922 level of 7.38 cents per kWh.

By 1981 the residential electricity price index, which covers certain fixed quantities of electricity consumed, increased 264.1 percent above the 1967 base of 100, while the Consumer Price Index (CPI) rose only 222.2 percent. With only five exceptions (1970, 1973, 1978, 1979, and 1985), the electricity price index has risen faster than the CPI for the last 16 years. However, the electricity index did not jump ahead of the CPI until after the 1973-74 oil embargo.

Table 2 shows that Americans spent 2.1 percent of their disposable personal income, or income after taxes, for household electricity in 1985, up from 1.4 percent in 1969. This outlay compares with 14.7 percent for food, 14.3 percent for housing, and 6.8 percent for clothing and accessories. The amount spent for electric services was less than two-thirds that spent on gasoline and motor oil. Total personal expenditures on energy used directly by households (electricity, gas, fuel oil, coal, gasoline, and motor oil) amounted to 7 percent of disposable personal income in 1985. EP

Contributed by the Statistics Department of Edison Electric Institute.

Table 1
RESIDENTIAL ELECTRICITY AND THE COST OF LIVING*

Year	Average Revenue per Residential Kilowatt-hour Sold (cents/kWh)	Price Index Numbers**	
		Residential Electricity (year's average)	Consumer (year's average)
1985	7.38	364.1	322.2
1984	7.14	351.8	311.1
1983	6.83	330.6	298.4
1982	6.44	320.3	289.1
1981	5.86	291.5	272.4
1980	5.12	253.4	246.8
1979	4.43	219.1	217.4
1978	4.03	203.4	195.4
1977	3.78	189.3	181.5
1976	3.45	177.6	170.5
1975	3.21	167.0	161.2
1974	2.83	147.5	147.7
1973	2.38	124.9	133.1
1972	2.29	118.9	125.3
1971	2.19	113.2	121.3
1970	2.10	106.2	116.3
1969	2.09	102.8	109.8

* Data include Alaska and Hawaii.

** The index numbers are percentages of the year 1967, used by the U.S. Bureau of Labor Statistics as the base period. Electricity index numbers cover fixed quantities of electricity used.

Sources: *EEI 1984 Statistical Yearbook* and Advance Release on *EEI 1985 Statistical Yearbook*, Tables 62 and 83.

Correction

In the Statistical Review, *Electric Perspectives*, Fall 1986, there were several errors in Table 1. In the production process, dollar signs ($) were inadvertently added on lines labeled "Residential Sales," "Total Sales," "New England," and "United States." The unit of sales was megawatts.

Table 2
DIRECT PERSONAL EXPENDITURES ON ENERGY AS PERCENTAGES OF DISPOSABLE PERSONAL INCOME, 1969-1985
(Millions of Dollars)

		Personal Consumption Expenditures Components of GNP				
		Household				
Year	Disposable Personal Income	Electricity	Gas	Fuel Oil and Coal	Automotive Gasoline and Oil	Total Direct Energy
1985	2,828,000	60,200	29,700	15,600	91,900	197,400
%	100.00	2.13	1.05	0.55	3.25	6.98
1984	2,670,600	55,400	29,400	14,500	90,700	190,000
%	100.00	2.07	1.10	0.54	3.40	7.11
1983	2,428,100	51,000	29,000	13,300	90,200	183,500
%	100.00	2.10	1.19	0.55	3.71	7.56
1982	2,261,400	47,100	25,700	11,800	89,100	173,700
%	100.00	2.08	1.14	0.52	3.94	7.68
1981	2,047,621	45,246	21,552	20,740	94,643	182,181
%	100.00	2.21	1.05	1.01	4.62	8.90
1980	1,828,854	38,098	19,471	18,591	84,765	160,925
%	100.00	2.08	1.06	1.02	4.63	8.80
1979	1,650,155	31,329	16,509	16,105	66,576	130,519
%	100.00	1.90	1.00	0.98	4.03	7.91
1978	1,473,991	28,503	14,380	11,915	51,242	106,040
%	100.0	1.93	0.98	0.81	3.48	7.19
1977	1,314,019	25,650	12,800	10,668	48,126	97,244
%	100.00	1.95	0.97	0.81	3.66	7.40
1976	1,194,359	21,940	10,973	9,824	43,973	86,710
%	100.00	1.84	0.92	0.82	3.68	7.26
1975	1,086,658	19,999	9,263	10,236	39,509	79,007
%	100.00	1.84	0.85	0.94	3.64	7.27
1974	984,627	16,503	7,589	9,562	36,431	70,085
%	100.00	1.68	0.77	0.97	3.70	7.12
1973	901,663	13,852	6,725	7,722	27,813	56,112
%	100.00	1.54	0.75	0.86	3.08	6.22
1972	801,299	12,314	6,541	6,270	24,879	50,004
%	100.00	1.54	0.82	0.78	3.10	6.24
1971	746,433	10,936	5,699	6,867*	23,498	47,000
%	100.00	1.47	0.76	0.92	3.15	6.30
1970	691,699	9,824	5,262	6,752*	22,211	44,049
%	100.00	1.42	0.76	0.98	3.21	6.37
1969	634,386	8,905	4,938	6,358*	20,894	41,095
%	100.00	1.40	0.78	1.00	3.29	6.48

*Designated "Other Fuel & Ice" rather than "Household Oil & Coal."

Source: Compiled by Statistics Department of EEI based on July issues of *Survey of Current Business*, U.S. Department of Commerce, since 1969.

REGULATORY REVIEW

ONE HEAD IS BETTER THAN FIVE AT NRC

When the Nuclear Regulatory Commission (NRC) was established in 1975, the goal was to assure regulatory control of the rapidly growing use of nuclear energy. Ironically, utilities' new commitments for nuclear plants essentially stopped about the time the Commission was formed. Every civilian nuclear plant ordered after the NRC was established has been cancelled or placed on indefinite deferral. Under present regulatory and institutional arrangements, no American electric utility would consider ordering a new nuclear power plant. The unpredictability and instability in the federal safety licensing process do not justify the gamble.

One critical cause of this stalemate has been the organizational structure of the NRC itself. The five-member leadership has proved both ineffectual and inefficient in dealing with the procedural and policy issues that confront the nuclear power industry—frustrating rather than facilitating timely action. Congress has the authority to rectify this problem by replacing the five-member structure with a single administrator.

The five-member structure of the Commission appears to be little more than historical accident. The Energy Reorganization Act of 1974 divided the existing responsibilities of the Atomic Energy Commission between the NRC and the Energy Research and Development Agency (now the Department of Energy). The NRC was to address the federal safety regulatory aspects of civilian nuclear power. President Gerald Ford observed that the technical nature of nuclear facilities and the potential hazards "warrant the creation of an independent and technically competent regulatory agency to assure adequate protection of public health and safety." However, there was little attention directed toward defining the proper organizational form to manage a comprehensive nuclear safety board. In fact, the current NRC structure contrasts sharply with the organizational structures of other agencies that deal with health and safety such as the Federal Aviation Administration, the Food and Drug Administration, and the Environmental Protection Agency. These agencies are located in the Executive Branch, headed by a single administrator who answers to the President.

Restructuring the Commission has been proposed a number of times by various groups. Most recently, at an April 1986 hearing of the Senate Energy and Natural Resources Committee, Secretary of Energy Herrington, NRC Chairman Palladino, NRC commissioners Zech, Robert, and Bernthal, and every other nuclear industry witness testifying, all endorsed the single administrator concept.

The evidence points to three crucial improvements that could be realized through the single administrator structure: improved management, improved policy formation, and clear accountability.

A principal finding of the post-TMI studies was that, under the agency's collegial management structure, the NRC was "an organization that is not so much badly managed as it is not managed at all." In a July 1984 article in *Nuclear News*, NRC Commissioner Gilinsky complained that the Commission's approach is to "nibble" at major issues rather than to confront them directly. Virtually all studies on this issue have concluded that a single administrator, who alone would possess full responsibility and authority for the efficient operation of the agency, would be able to manage more effectively than a commission in which authority and responsibility are spread among five commissioners. In 1971, the President's Advisory Council on Executive Organization attributed the managerial inefficiency of the commission form to "the ambiguity of direction inherent in the separate authority vested in each of the members."

Faced with the institutional and interpersonal obstacles inherent in arriving at consensus positions, the Commission often lets its policy-making responsibilities fall by default to its regulatory staff and to case-by-case decisionmaking by its licensing boards. A 1980 report by the General Accounting Office (GAO) found the NRC slow in recognizing policy needs and in developing new policies. The GAO report concluded that "despite the importance of policymaking to nuclear regulations, the Commissioners have generally left to the NRC staff decisions on when new policies are needed, which new policy requirements should receive policy attention, and how policies should be written."

A single administrator would not formulate policy more effectively by eliminating debate and disregarding diverse viewpoints. On the contrary, he or she would be presented with the views of licensees, intervenors, the public, staff experts, and advisory groups—the same range of views now presented to the Commission. However, the single administrator would not be impeded by institutional obstacles in making the necessary hard choices after weighing competing views.

Under the current NRC structure, diffused authority results in diffused accountability. By law, each member of the Commission, including the Chairman, has equal

responsibility and authority in all decisions and actions that concern policy formation, rulemaking, orders and adjudications, and senior NRC appointments. This structure makes it difficulty to fix responsibility. A single administrator—and the President who appoints that official—would be unmistakably accountable for performance not only to Congress but to the public at large. Experience has proved that political accountability is a powerful safeguard of public interest.

Two major criticisms have been leveled at the single administrator approach to NRC management: loss of diversity in agency decisionmaking and lessened public visibility of the regulatory process. However, there are persuasive responses to each of these criticisms.

The proponents of "diversity" argue that the controversial nature of nuclear issues mandates a collegial body to reflect disparate viewpoints. Proponents of a single administrator argue that it is not the proper function of the Commission or an administrator to resolve competing public attitudes toward nuclear power in every individual safety decision. Indeed, the pressure to play this role has paralyzed the Commission over the past few years. The Executive and Congress should make the decisions that involve a balancing of the risks against the benefits of this technology. The administrator would shape policy and procedures to implement those decisions effectively.

The argument that a single administrator would reduce the public visibility of policymaking turns on the fact that a single administrator would not be subject to the strictures of the Sunshine Act. However, NRC rulemaking still would be conducted under public notice and comment procedures; the licensing and regulatory process would remain open to public scrutiny; licensing and technical issues still would involve public meetings; virtually all of the agency's papers would remain publicly available, and the Freedom of Information Act would continue to apply. In short, the nuclear regulatory process would remain as open and visible as it is today.

Last summer, a series of Senate hearings reviewed the adequacy of electricity supply for the coming decade. Industry analysts and economists predicted a serious gap between supply and demand. Though the technology for nuclear power was developed in the United States, this option largely has disappeared here—while other industrial nations, such as France, Japan, and West Germany, are securing an international competitive edge by using nuclear power as the cornerstone of their electrical supply. The U.S. nuclear power industry continues to make remarkable progress in ensuring the efficiency, productivity, and safety of domestic nuclear power plants. However, the current regulatory and institutional barriers continue to frustrate these efforts.

Replacing the existing NRC structure with a single administrator could be the first step in removing the barriers to a secure energy future. Strong, centralized, and consistent administration at the NRC could help bring about needed reforms in licensing and regulation, securing safety and environmental protection without paralyzing the growth and productivity of a critical industry.

Contributed by Mark Reynolds, who has written extensively on electric utility issues.

FEDERAL-STATE RATE BATTLES: THE SUPREME COURT RETURNS TO THE FRAY

On June 17, 1986, the United States Supreme Court released a landmark decision in *Nantahala Power and Light Co. v. Thornburg*, 106 S.Ct. 2349, 54 U.S.L.W. 4676.[1] Acting unanimously in an opinion by Justice O'Connor, the Court reversed a decision of the North Carolina Supreme Court and held that

> When FERC sets a rate between a seller of power and a wholesaler-as-buyer, a State may not exercise its undoubted jurisdiction over retail sales to prevent the wholesaler-as-seller from recovering the costs of paying the FERC-approved rate. 106 S.Ct. 2349, 2359; 54 U.S.L.W. 4676, 4681.

The Court thus reaffirmed its "filed rate" doctrine and refreshed the edges of the "bright line" between federal and state rate jurisdiction, a line it had drawn more than 20 years earlier.[2]

Action by the North Carolina Utilities Commission requiring Nantahala to compute its rates to North Carolina retail customers *as if* it had received more inexpensive hydropower entitlements from the Tennessee Valley Authority than it had been allowed in fact by the Federal Energy Regulatory Commission (FERC) led the Court to conclude that Nantahala had incurred "trapped" costs (between federal and state regulatory requirements) that could never be recovered if the state decision were permitted to stand. Thus, the state decision constituted an "impermissible interference" with the "scheme of federal regulation," and the Supreme Court struck it down.

Despite the Supreme Court's ruling, struggles over conflicts in rate

jurisdiction have not ended. A good deal more skirmishing can be expected as utilities, their customers, and state agencies seek to come within or to avoid the Court's holding in *Nantahala*. For example, the Court noted that higher purchased power costs under rates approved by the FERC may not necessarily lead to higher retail rates if the utility has effected savings in other areas that might offset the increased purchased power costs. Further, the Court expressly reserved decision on issues arising in cases like *Pike County Light & Power Co. v. Pennsylvania Public Utility Comm'n.*, 77 Pa. Commw. 268, 465 A. 2d 735 (1983), where a buyer's FERC-approved purchased power cost was alleged to be imprudently incurred—not because the *rate* approved by the FERC was considered too high, but because lower-cost power was considered by the state public utility commission to be available from another source.

It is apparent that, where the bare issue presented is the prudence of a buyer's choice among alternate, interstate power sources in an ordinary bilateral transaction, in order to prevail, the buyer will have to convince the state commission and reviewing courts that its choice was either dictated or approved by the FERC, thus establishing a federal requirement. However, where a multistate, federal "scheme" is clearly present and would be affected by state commission action, the FERC will exercise its exclusive jurisdiction over interstate transmission and pooling arrangements and will interpret related agreements without contradiction by state agencies. The FERC recently held that

> Under these circumstances, more complex, interrelated questions arise and, whether one characterizes the questions as related to prudence, interpretation, or cost allocation, they are clearly matters most appropriately resolved by this Commission as part of its overriding authority to evaluate and implement all applicable wholesale rate schedules. *AEP Generating Co.*, Dkt. No. ER84-579-005, Order on Rehearing (Aug. 20, 1986) slip op. at 5.

The *Nantahala* decision supports this position and clearly establishes that multistate power supply arrangements, particularly power pooling and similar transactions involving FERC cost allocation, are subject to *exclusive* FERC regulation so that states may not act inconsistently with FERC action in setting retail rates for the utilities involved.

Important, unresolved legal questions remain, both substantive and procedural. A substantive issue is whether and, if so, to what extent, FERC jurisdiction over a "sale" of electricity for resale in interstate commerce confers jurisdiction upon the FERC to regulate the activities and prudence of the buyer. On the procedural side, utilities have petitioned the Supreme Court to clarify conflicts among the federal circuit courts as to when, if ever, a federal district court should abstain from adjudicating a claim that the Federal Power Act preempts a state utility commission from acting upon matters within the jurisdiction of the FERC. Other cases that raise related issues and were initiated before *Nantahala* was decided also are proceeding toward the Supreme Court. The Court may resolve them on the basis of its June 17 decision, thus reducing and, ultimately, ending litigation over the scope and implementation of federal rate regulation—at least until the next onslaught of high costs and imaginative combatants. EP

Notes

1. See "Federal-State Rate Battles: Is the War Almost Over?" *Electric Perspectives*, Summer 1986, p. 28.

2. *FPC v. Southern California Edison Co.* 376 U.S. 205, 215-216 (1964).

Contributed by Carl D. Hobelman, senior partner in the Washington, D.C., law firm of LeBoeuf, Lamb, Leiby & MacRae.

BOOK REVIEW

DO YOU KNOW YOUR COMPANY ROOTS?

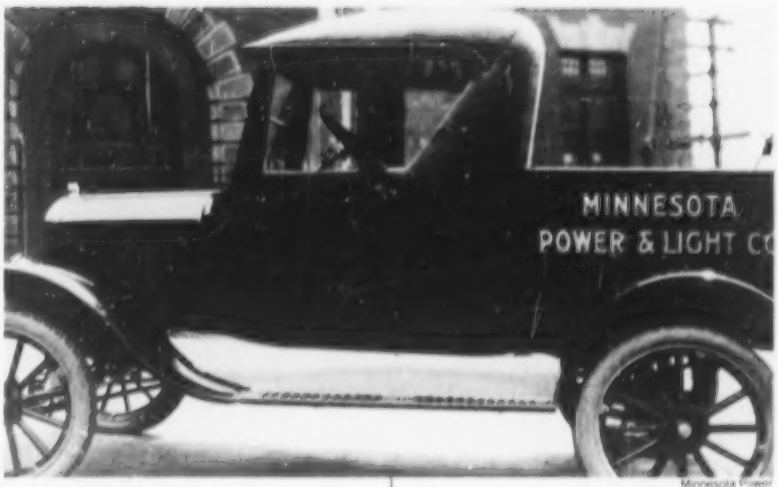
By Bill Beck

A recent issue of Kentucky Power's employee magazine said that seven out of every ten of the utility's employees are now between the ages of 25 and 44.

The statistic didn't particularly surprise me. The percentage is similar here at Minnesota Power, and I suspect it holds true at a good many other electric utilities around the country. What it points out is that the baby boom generation, born between the end of World War II in 1945 and the election of John Kennedy in 1960, is now firmly ensconced in the workforce of the nation's electric utility industry.

One intriguing result is that many utility employees are ignorant of company roots. This may not sound all that important. But it is. Without an understanding of the corporate past, how can tomorrow's management avoid reinventing the wheel? Why did the company build coal-fired generation in the 1930s rather than continue to develop hydroelectric sites? What were the reasons for selecting 230 kilovolts as a standard for transmission in the region during the 1960s? How did state and local politics affect the company's decision to build a nuclear generating unit in the 1970s?

Creating a historical consciousness at an electric utility isn't done overnight. But it has been done by a number of utilities, and if done well it can pay dividends in planning and in employee, customer, and shareholder relations. At Minnesota Power, senior management wanted to acquaint both employees and customers with the company's history. With that objective in mind, we created a 17-minute slide/tape presentation in 1983 called "Minnesota Power: People, Places, Past." The audio-visual presentation was completed in time for the 1984 annual meeting of shareholders and was then shown to all of the company's 1 200 employees and some 400 retirees. Since then, the presentation has been made to nearly 100 customer and community groups, and the public affairs department has used the videotape version to help orient employees of newly-acquired diversified businesses to the corporate culture of Minnesota Power.



Minnesota Power

The natural outgrowth of the slide/tape presentation was a written history, which was published in the spring of 1986. *Northern Lights: An Illustrated History of Minnesota Power* was printed in both hardcover and soft-cover editions a. J made available as a gift to employees and retirees. Review and complimentary copies were sent to general and industry media, utility chief executives, and regional business and community leaders. Remaining copies were sold at cost to interested shareholders and customers.

The final piece of Minnesota Power's history program is coming together with the completion next year of a permanent museum display at the St. Louis County Heritage and Arts Center in Duluth, Minnesota. The display will recreate the 1910 offices of the Duluth Edison Electric Company, one of the utility's urban retail predecessors. It should be a tangible reminder to the community that Minnesota Power has been an integral part of northern Minnesota business for generations.

Minnesota Power certainly isn't alone in spotlighting its past. Boston Edison, although it did not publish a book marking its centennial, did some innovative things with calendars and community celebrations early in 1986. Consolidated Edison runs a fascinating electrical museum in lower Manhattan, as does the Salt River Project in Phoenix. Washington Water Power produced an award-winning film on the history of electric power development in the Pacific Northwest, and National Rural Electric Cooperative Association capitalized on the 50th anniversary of rural electrification with a coffee-table book and a full slate of speaker services.

Electric utilities are becoming far more sophisticated in what they choose to publish about corporate history. No longer are company histories just public relations puff pieces or the bowdlerized memoirs of a retired chief executive. *Northern Lights* recounted the financial abuses that plagued the industry in

the 1920s along with the engineering innovations that gave the industry increasing credibility in the 1950s and 1960s. Reviews both in the trade press and from the academic community gave Minnesota Power credit for telling the whole story.

Others have told the story as well or better. *Iron Men and Copper Wires* by William A. Myers set an industry standard with its history of Southern California Edison. Carol Pine, a consultant, gave us a readable, anecdotal account of Northern States Power with *NSP People*. In a more academic vein, John Murray chronicled the history of Iowa Electric in *It Took All of Us*, and Gus Norwood's *Columbia River Power for the People* is a comprehensive history of the Bonneville Power Administration.

New interest in the nation's infrastructure among academic historians bodes well for a better understanding of electric power development. Roece Jenkins is spearheading a massive project to catalogue and publish the Edison Papers at Rutgers University. Thomas Parke Hughes, the author of the definitive *Networks of Power* and the dean of electric utility historians, has turned the Department of the History of Science and Technology at the University of Pennsylvania into a breeding ground for utility historians. Some of the best work in the field today is being done by Hughes' students, including Bayla Schlossberg Singer's dissertation on the history of the Pennsylvania-New Jersey-Maryland Interconnection and Robert Belfield's dissertation on the history of the Niagara Power Project.

"History," claimed Henry Ford, "is bunk." I disagree. It allows us valuable insights into who we are and how we got that way. An electric utility industry that is top heavy with baby boomers and facing the unprecedented challenges of deregulation, diversification, and decentralization needs to have a keen sense of where it has been.

Bill Beck, senior writer in the Public Affairs Department of Minnesota Power, is the author of Northern Lights: An Illustrated History of Minnesota Power and is currently writing a history of the Mid-Continent Area Power Pool.

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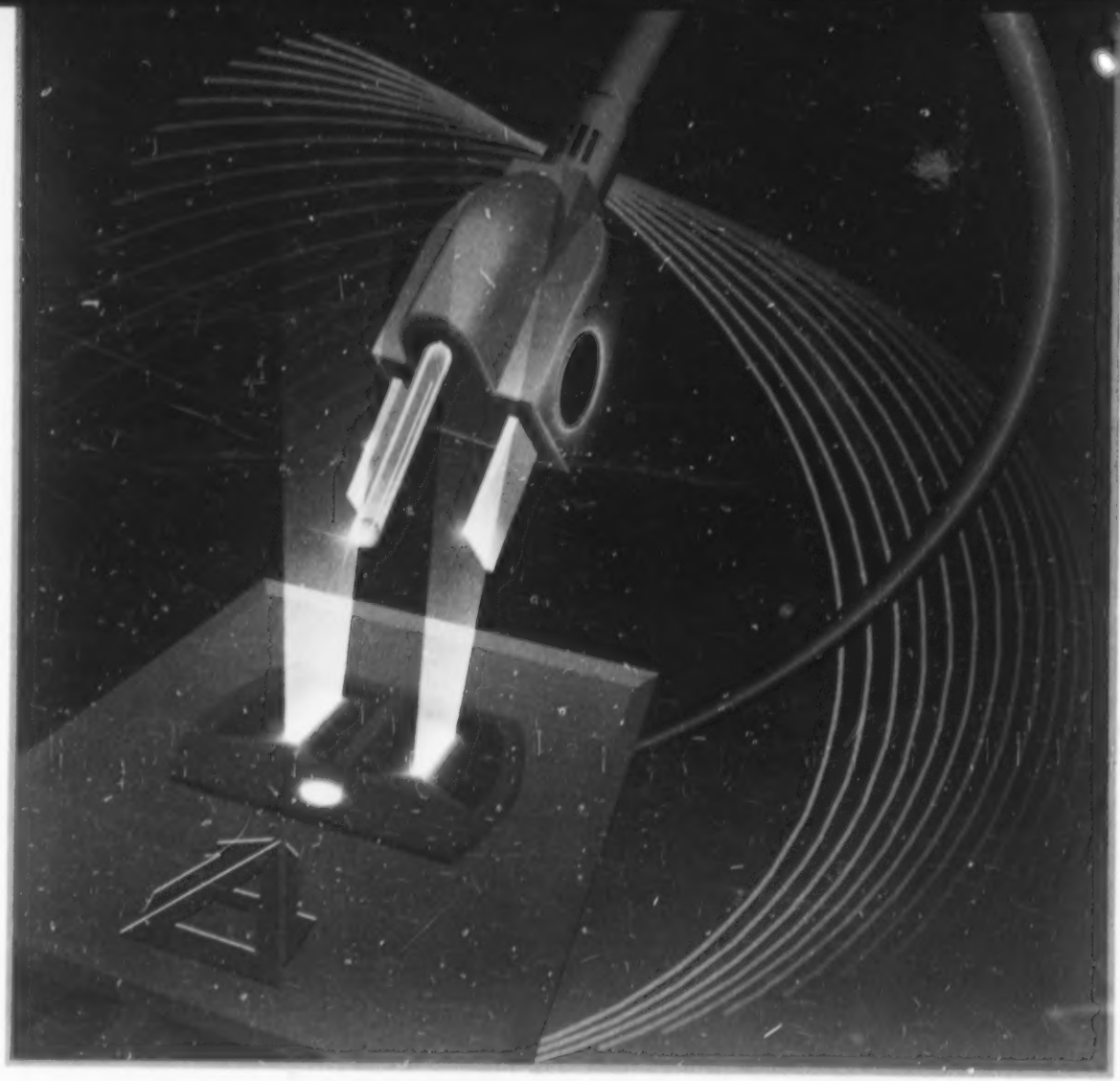

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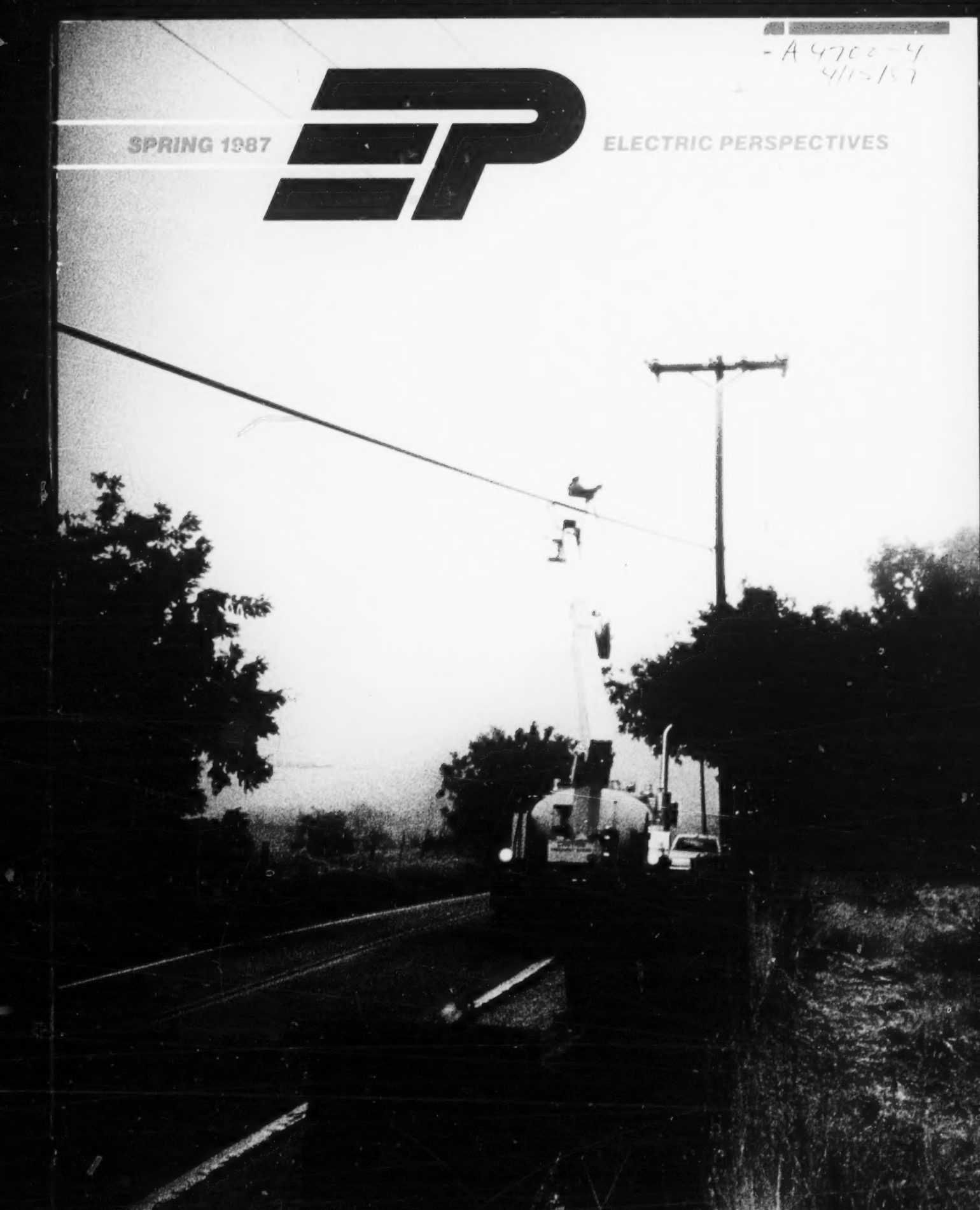

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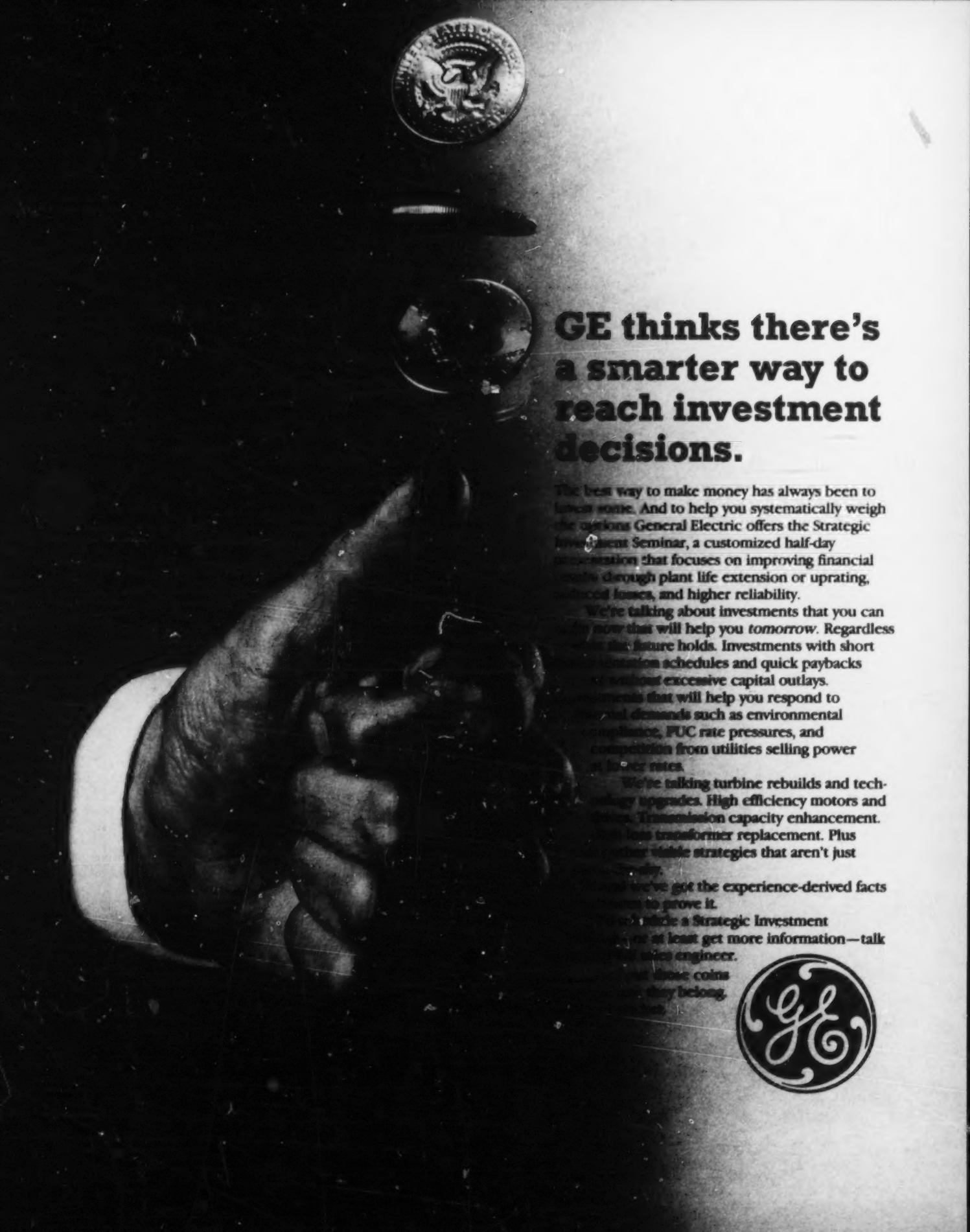

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Cover: A Southern California Edison lineman waters down a power pole to help maintain service during a major fire. Photo courtesy of Southern California Edison Company.

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A PERIODIC REPORT FROM BURNS AND ROE — SPRING, 1987

Cobean, Bartoli are promoted in corporate restructuring move

K. Keith Roe, president and chief operating officer of Burns and Roe Enterprises, Inc. (BRE), has announced several key management changes.

W.R. "Bus" Cobean, Jr., formerly president of Burns and Roe Company—the division that serves electric utilities worldwide—is now senior corporate vice president of BRE, the parent corporation. He reports to Kenneth A. Roe, chairman of the board and chief executive officer of BRE. Cobean was also elected to the board of directors of BRE.

Henry E. "Hank" Bartoli, who was profit center manager for fossil plant services, has succeeded Bus Cobean as head of Burns and Roe Company, with the title of vice president and general manager.

Cobean

Bartoli

Donald L. Conner, who was vice president and assistant to the president of BRE, is now vice president and general manager of the Burns and Roe Construction Group, which performs all construction tasks for the Burns and Roe family of companies.

Jeffrey T. Whipple, formerly chief mechanical engineer, is now deputy director of the Engineering and Design Division of BRE. He reports to E. Richard Kummerle, president of the Division.

The appointments were made to meet the continuing needs of the marketplace, Keith Roe explained. "These changes will continue to improve our positioning in our key markets," said Keith Roe, "and will set the course of our operations for some time to come. I believe it will strengthen our ability to be responsive, efficient, innovative and aggressive in the marketplace."

After a distinguished career in the U.S. Navy, Bus Cobean joined Burns and Roe in 1974. He established the company's Operating Plant Services Division in 1980 and was named president of Burns and Roe Company in 1985.

Conner

Whipple

Nuclear, fossil services realigned

As part of the restructuring of Burns and Roe Company, services offered to electric utilities in both nuclear and fossil-fired technologies have been consolidated.

Nuclear services, which had previously been divided into two separate operations—new projects and services to operating plants—are now combined under the direction of Thomas W. DiFransico, profit center manager, nuclear power.

Fossil services, which had also been divided into new projects and services to operating plants, are now combined under the direction of J. Alan Forrest, profit center manager, fossil power.

Tom DiFransico, an Annapolis graduate, joined Burns and Roe in 1975 and worked on numerous nuclear projects, including the Clinch River Breeder Reactor Plant. He was named to head the Nuclear Plant Services Division in 1985.

Alan Forrest worked for the United Kingdom Atomic Energy Authority, Atomic Energy of Canada and GE before joining Burns and Roe in 1969. He became director of fossil power projects in 1985.

Hank Bartoli joined Burns and Roe in 1969 and worked on many key nuclear power plant projects before becoming a project manager in 1978. He was named profit center manager for fossil plant services in 1985.

Don Conner joined Burns and Roe in 1986 upon his retirement from the U.S. Navy after a career that culminated with his appointment as director of construction in the Office of the Secretary of Defense. Previously he was responsible for the Navy's shore facility support around the world.

Jeff Whipple started with Burns and Roe in 1972 and held various positions until 1980, when he was named supervising mechanical engineer. He became chief mechanical engineer in 1985.

Conceptual design begins on next generation of nuclear plants

Burns and Roe is currently performing conceptual design studies for a new generation of advanced light water reactors (ALWR's) that will power the nuclear generating plants of the 1990's and beyond. This makes Burns and Roe one of the first architect/engineers to participate in the development of a new nuclear power plant concept in almost a decade.

Burns and Roe is teamed with Westinghouse under a three-year contract from the U.S. Department of Energy to continue efforts previously initiated under the Electric Power Research Institute's ongoing ALWR program.

The U.S. government has clearly decided that light water reactor technology is the only realistic option for power generation in the next decade. The government has also established, as one of its national priorities, the maintenance of a competitive U.S. technological capability, as well as the enhancement of safer, more reliable and more cost-effective LWR's.

Burns and Roe's efforts are concentrated on conceptual design studies for a relatively small (600 MWe) LWR plant which will have significant advantages over current plant designs of this size. The objectives are to improve safety margins, reduce plant capital and operating costs, simplify plant systems and components, and reduce construction risk, schedule and cost.

One of the design alternatives for the reactor coolant system involves hermetically sealed reactor coolant pumps, which can simplify plant systems, increase plant availability, reduce occupational radiation exposure, and reduce plant maintenance costs.

Another goal is a "passive walkaway safe design" which, in case of an accident, requires little operator action. Burns and Roe will also investigate and evaluate the use of modularized construction techniques in order to reduce construction costs and shorten schedules.

Dajani heads BRISC

BRISC is the Burns and Roe Industrial Services Company. It is the Burns and Roe division that provides engineering services to industrial, commercial, environmental and governmental markets. BRISC also occasionally performs work for electric utilities of a non-power plant nature.

Dajani

As part of Burns and Roe's restructuring, Ashraf T. Dajani became vice president and general manager of BRISC. He succeeded John T. Foti, former president of BRISC, who resigned.

Ash Dajani is no stranger to electric utilities. He has been with Burns and Roe since 1970, working on a wide variety of power plant projects as a mechanical engineer, project engineer, assistant project manager and profit center manager.

The fate of billions of dollars of utility investment depends on the current application of an ancient legal concept.

James R. Tourtellotte

An Anatomy of Prudence

It's high time to make prudence make sense.

Public utility commissions throughout the United States are increasingly using the legal theory of prudence as a basis for disallowing the inclusion of hundreds of millions of dollars of costs into a utility's rate base. The Kansas commission disallowed $282 million for the Wolf Creek nuclear plant; the Missouri commission, $384 million for Callaway; the Michigan commission, $397 million for Fermi 2; the California commission, $329.9 million for San Onofre; and the New York commission, $1.4 billion for Shoreham. These cases represent only a part of the billions of dollars at stake.

Clouds Gather

Commissions are expanding the scope and depth of prudence reviews. Although prudence is frequently applied to construction cost overruns and plant cancellations, commissions are also using prudence for reviewing costs associated with excess capacity and extended outages for maintenance. In short, there is movement in the direction of applying prudence in any case where the utility makes a substantial expenditure of money.

A number of factors have contributed to the increased use of the prudence theory by utility commissions. In large part, the increased concern comes from the cumulative effect of the oil embargo, increased costs of construction and operation due to inflation and regulatory requirements, decreased demand because price elasticity limits were exceeded, reversal of economies of scale, and the growth of energy conservation. These factors have synergistically driven utilities' cost of service for new plants to unprecedented levels.

Allocation and integration of higher costs into the rate base have created problems for both the utilities and the regulators. How does a commission integrate into a utility's rate base costs that are greater than ordinary inflationary costs? How can this be done in a post-inflationary period when the public psyche has adjusted to lower inflation? In short, how can utility commissions accommodate these costs without running a high risk of losing public acceptance?

On the other hand, utilities are concerned about the effect of increased costs upon their economic viability. In the final analysis, utilities are service-oriented economic institutions. Capital structure, cash flow, and the ability to attract future capital are all essential to providing service and remaining in business. In addition, utility executives are increasingly aware that competitive pricing is fundamental to economic survival. Moreover, most people in the utility industry recognize the susceptibility of the regulatory process to public opinion and the adverse effect such opinion can have on the ability of a utility to provide service and stay competitive.

These differing perspectives of utilities and regulators are at the root of virtually every prudence dispute. The dispute revolves around who should bear the risk for certain investment decisions and, ultimately, how costs should be allocated between ratepayers and stockholders. Utility commissions have turned to the prudence theory as a process for resolving these disputes.

James R. Tourtellotte is a consultant on utility management, regulatory affairs, and litigation. He is also a partner in the law firm of Tourtellotte, Ross and Gray, Washington, D.C.

What is "Prudence"?

Prudence is a legal concept that has its roots in both Roman and English common law. The term has been variously applied in the law to define the standard of care one must use in conducting affairs that may affect others. In the utility industry, the utility is expected to exercise care in making all of its expenditures because such expenditures may adversely affect the ratepayers' cost of service and because ratepayers are not in a position to control investment decisions. The concept of prudence is applicable not only to capital investments but also to operating expenses. This article, however, addresses prudence in the context of capital investment.

The genesis of the "prudent investment" test as applied to public utilities' capital investments is generally acknowledged to be in the separate opinion of Justice Brandeis in the U.S. Supreme Court case of *Missouri ex. rel. Southwestern Bell Telephone Company v. Public Service Commission*, 262 U.S. 276, 289 (1923). In this opinion, Brandeis states:

> The term prudent investment is not used in a critical sense. There should not be excluded from the finding of the base, investments which, under ordinary circumstances, would be deemed reasonable. The term is applied for the purpose of excluding what might be found to be dishonest or obviously wasteful or imprudent expenditures. Every investment may be assumed to have been made in the exercise of reasonable judgment, unless the contrary is shown.

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In 1923, Justice Brandeis argued utility investment decisions should be presumed prudent unless proven otherwise, a ruling echoed by the National Research Institute in 1985.

Brandeis did not define "prudence." He simply introduced the concept of prudence as a means of determining the nature of a reasonable investment. What he says initially is that dishonest is not reasonable, obviously wasteful is not reasonable, and imprudent is not reasonable.

Brandeis makes reference to a presumption of prudence when he states "every investment may be assumed to have been made in the exercise of reasonable judgment, unless the contrary is shown." Initial presumptions of proper conduct are not unusual in the law. A complainant generally has an obligation to demonstrate that a defendant's conduct is improper in order to overcome the presumption and prove the complainant's case. Yet, in a number of jurisdictions, commissions have rejected the idea that there is a presumption of prudence.

Brandeis' opinion touches on important points, but leaves us with no concise definition of prudence. However, general legal theory suggests the following definition. Prudence is a standard of conduct owed by a utility to avoid financial injury to its ratepayers in the conduct of its business. In the context of capital investment decisions, factors to be taken into account in determining whether the utility's decisions meet the prudence standard include the circumstances in which the decision was made, the reasonable range of options available to the utility at the time the decision was made, the evaluation of those alternatives, and the reasonableness of the alternative selected. This definition sets forth both the duty owed by a utility to its ratepayers and the standard for determining how that duty can be met.

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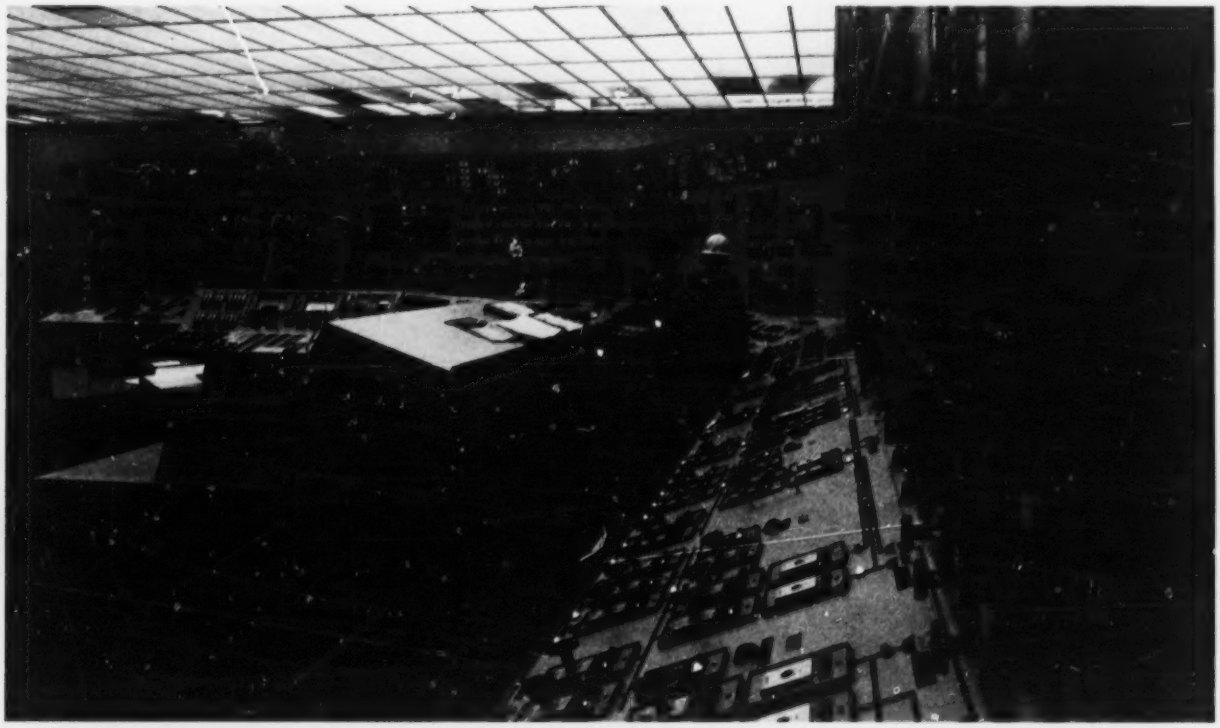

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Nuclear investments have been a frequent target of prudency reviews.

Testing for Prudence

The purpose of prudence is to protect the rights of individuals who are affected by investment decision-making but have no control over it. A prudence standard is not a standard of perfection. It may require, however, avoidance of intentional exposure to substantial unnecessary risk where the individuals not in control could suffer financially.

In a work entitled "The Prudent Investment Test in the 1980s," April 1985, the National Regulatory Research Institute sets out four guidelines for application of the prudent investment test. These are:

1. That there should exist a presumption that the investment decisions of a utility are prudent.
2. That courts and administrative bodies should use the standard of reasonableness under the circumstances, that is, circumstances that were known or could reasonably have been known at the time the decision was made.
3. That there should be a proscription against the use of hindsight to determine prudence.
4. That prudence should be determined in a retrospective, factual inquiry.

These guidelines are eminently fair and generally reflect the accepted practice of discerning courts and commissions. However, some commissions have specifically rejected the presumption of prudence. Others clearly appear to have rejected guidelines two and three by substituting present knowledge and the impact of known results for what reasonably could have been known at the time and in the circumstance of the original decision.

A cursory examination of criteria three and four might lead the reader to believe there is a contradiction: there is none. The purpose of the proscription against hindsight—a substantive guideline—is to preclude a commission from judging the quality of a utility's decision on the basis of the final outcome of that decision. The fourth guideline—a procedural guideline—recognizes that facts describing the circumstances in which a past decision was made can only be ascertained by a retrospective investigation. The point of guideline four is that the purpose of such an investigation is to discover historical business facts, not to engage in hindsight.

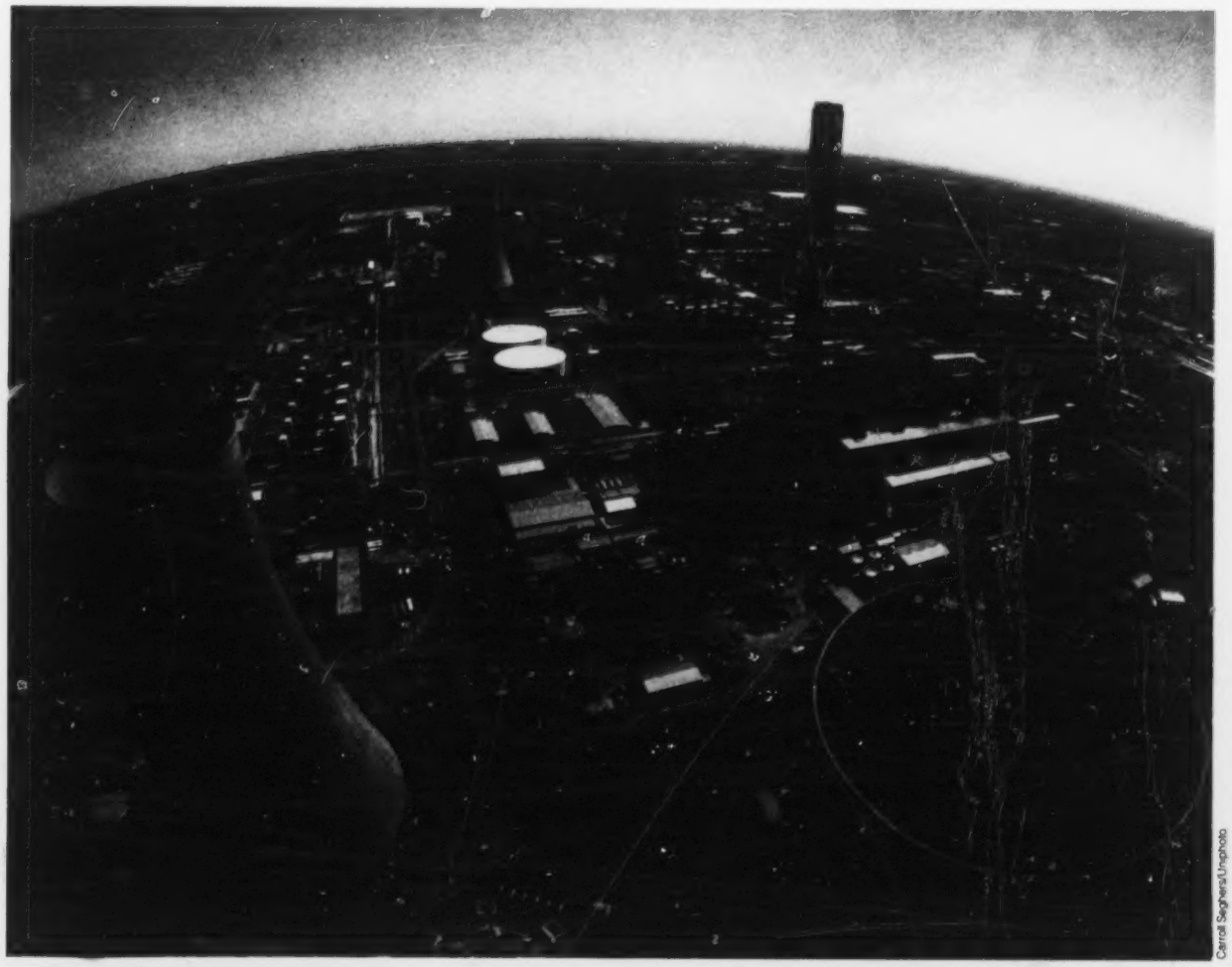
The question of how to test an assertion of imprudence was addressed in testimony before the Public Utilities Commission of California in the San Onofre nuclear plant rate case by Professor Ronald

Fox of the Harvard University Graduate School of Business Administration. Professor Fox suggested a test using a series of inquiries:

- Does the assertion bring to bear a fair, comprehensive, and accurate description of the factual setting in which the management decision was made?
- Does the assertion persuasively demonstrate that the process used by managers was substandard in comparison with the management processes commonly used in similar contemporaneous undertakings?
- Does the assertion fairly and comprehensively consider the alternatives within the range of reason that were then available to management?
- Does the assertion avoid the fallacy of attempting to characterize the quality of the management process by assessing the desirability of the results?
- Does the assertion reason from the perspective of the manager with responsibility for the decision and take into account the constraints on the information realistically available to that manager?
- Does the assertion demonstrate that the challenged decision led to an undesirable outcome that would have been avoided by reasonably available alternatives?
- Does the assertion demonstrate that the avoidance of an undesirable outcome would not have been accompanied by equally or more costly outcomes in that activity or other activities?

This test appears to be consistent with the guidelines set out by the

How does one retroactively evaluate the prudency of the thousands of decisions made during the construction of new plant?



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National Regulatory Research Institute and the definition of prudence based on general legal theory offered earlier.

Yesterday's Decisions—A Tangled Web

There are a number of complex problems that arise in the application of the prudence standards and guidelines. These problems stem from the nature of decisions, evaluation of decisions, and sequence of decisions. By nature, decisions can be formal or informal, written or verbal, explicit or implicit, *pro forma* or need-specific. In the construction of a power plant, most major decisions will be formal and will be accompanied by some documentation. However, there are also thousands of informal decisions that are usually made verbally. To recapture the factual circumstances of informal decisions is extremely difficult, particularly because of the passage of years, the difficulty of finding the people who made such decisions and, once found, getting them to remember with precision.

In addition to the informal decisions communicated verbally, there are thousands of other decisions which are the result of implicit or unilateral undertakings by individuals. For example, a manager may mentally go through a decisionmaking process to solve a work problem and implement the solution without documentation. It is virtually impossible to determine how many such decisions are made and their individual or cumulative effect on the project.

Evaluating decisions made yesterday carries with it all of the problems associated with reconstructing any historical circumstance. It is easy enough to say that prudence requires a retrospective factual inquiry. But how does one go about ascertaining the facts, problems, available alternatives, evaluation of alternatives, and the propriety of the alternatives selected?

Decisionmaking is extremely complex. It requires consideration of a broad range of issues including those that are environmental, economic, social, and political. In constructing a large project, one must

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When faced with integrating the multibillion dollar cost of new plant into the rate base, some commissions use hindsight to question the prudency of utility decisions made years earlier.

consider schedule, maintaining schedule sequence, change control to adjust sequence, costs, labor relations, and the application of manpower and materials. In addition, consideration must be given to intangibles like morale, goodwill, pleasing regulators, and, in some cases, public opinion. Moreover, in order to reconstruct the circumstances of the problems and the available alternatives one must not think of problems as they are currently known to have existed. Rather, one must think in terms of the perceptions of problems, risks, and uncertainty as applied to various alternatives at the time the original decision was made.

The following questions must also be answered. Did the right people have inputs? What were the value trade-offs? What was or was not foreseeable? What was the basis for selecting the exercised alternative? Was it timely? Did changing circumstances later require adjustment? This list of questions can go on at considerable length.

It is difficult to apply such questions to a single decision. To gain an appreciation of the enormity and complexity of a prudence case, multiply that number of questions times the thousands of decisions that must be made during the course of power plant construction.

If this is not mind-boggling enough, consider also that decisions and the need for decisions tend to be both sequential and overlapping in any large undertaking carried out over a long period of time. This interaction and interdependence of decisionmaking adds still another dimension to the prudence labyrinth.

Politics: Muddy Waters

Courts are generally vague in applying the concept of prudence to utility decisions. Consequently, state commissions are not constrained to follow well-stated legal principles in their interpretation and application of the prudence concept. The result is an elaboration of vagueness and the creation of confusion, leaving the door open to political exploitation of the ratemaking process.

Politics should not rule in prudence cases, legal standards should. Unfortunately, regulators in some jurisdictions seem to have been unduly influenced in their decisions by short-term political considerations. Although short-term advantage may be achieved, the long-term effects are to create a regulatory Babylon where very little of anything makes sense. Adhering to reasonable legal standards, on the other hand, assures a more consistent model will be used to measure and balance interests. Moreover, a utility is entitled to a clear articulation of the standards prior to construction of the project. In most cases, this is not done. *Ex post facto* standards are no standards at all.

Several factors are characteristic of a regulatory body whose decisions are motivated by political expediency. First, decisions tend to be stated in conclusory terms and few

John Riley-Foto, Inc.

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standards are expressed. A simple declaration that a standard exists is insufficient to establish a standard. Criteria must be articulated. These criteria must build an authoritative model by which the quality of performance can be consistently measured. Without such a model, there is no real standard. Moreover, the absence of a model leaves the door wide open to the exercise of arbitrary decisionmaking by the commission. No guidance is given to those whose interests are affected about what the standards are.

Second, the stated basis for regulatory action is irrational and usually strained to achieve some transparently insupportable result. Irrationality may be marked by a departure from accepted legal standards or the creation of some new untried approach.

Third, the regulatory body tends to utilize personnel or consultants who are unqualified, biased, or both. Several state commissions have employed consultants who have no experience in constructing power plants to audit power plant construction. Some commissions have also hired consultants with a history of consistent opposition to nuclear power to review the prudence of nuclear investments.

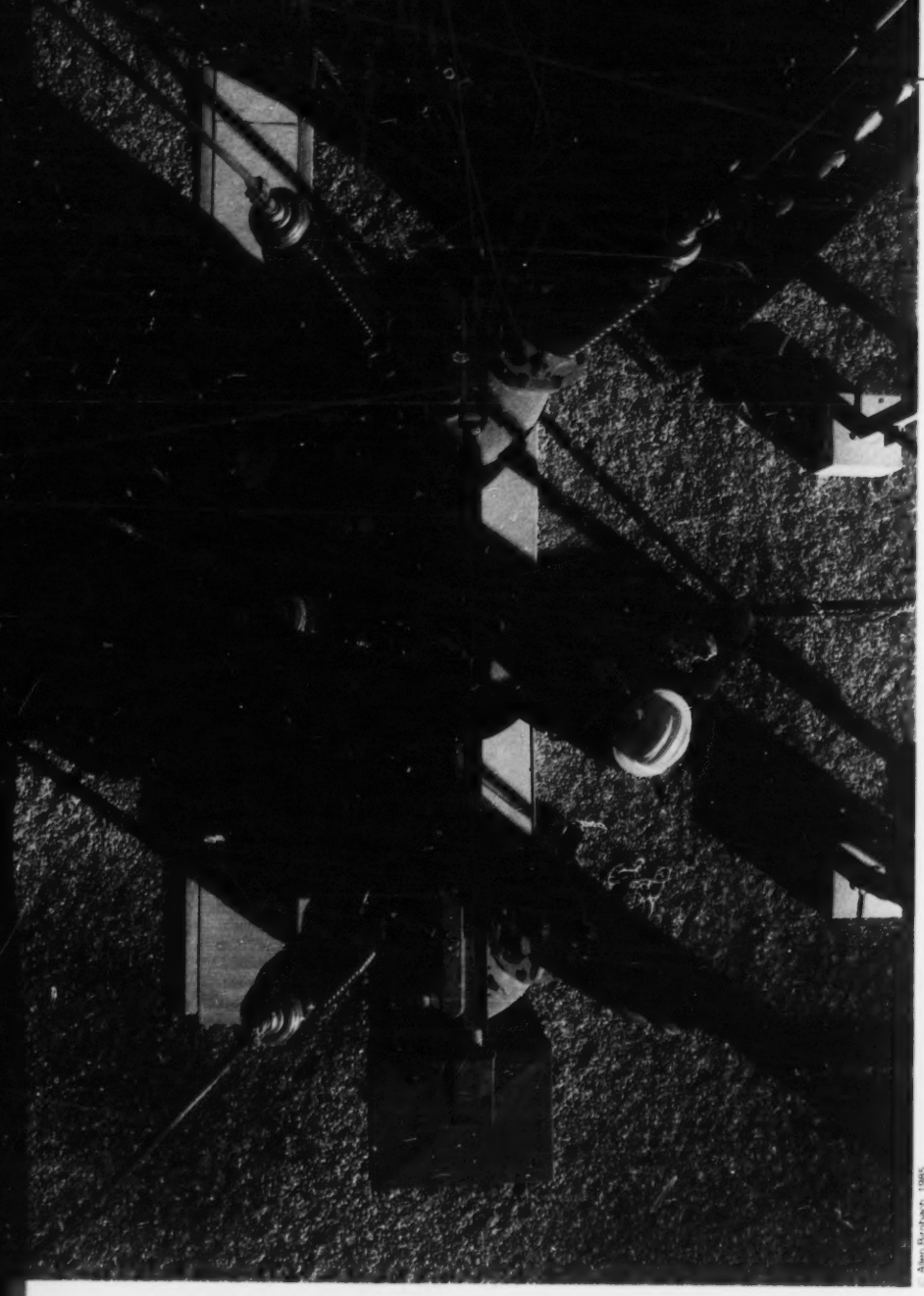
Fourth, overt political action by commission candidates or appointing authorities may also signal the dominance of political expediency. For example, during their terms of office, some governors have made utilities a political target. One governor even participated in public demonstrations against utilities at the same time he served as the appointing authority for his state's commission.

When acting in their judicial capacity, regulators are expected to be like judges, not politicians. In adjudication, regulators must put aside preconceived notions and political agendas. They must be open-minded, objective, and even-handed.

It should not be inferred that all regulatory bodies are motivated by political expediency. Many have diligently pursued established standards and made difficult decisions having potentially threatening political consequences. In the final analysis, they met their responsibilities as regulators to balance interests. But the importance of politicization of the regulatory process can not be de-emphasized. It poses a serious threat to the regulatory compact and the public interest.

Action, Surprise Reaction

Those regulators involved in prudence reviews should pause to consider the economic effect of their actions. Actions that well-inten-



Any action or inaction that results in the expenditure of money may be subject to a prudency review.

tioned regulators believe protect ratepayers in the near term may actually harm them in the long run.

The potentially adverse consequences of large disallowances are numerous and varied. At minimum, large disallowances may build a psychological barrier against, and may result in company policies preventing, investment in new capacity. Without new capacity, the likelihood of brownouts or blackouts increases and the quality of service to customers may be seriously impaired.

Moreover, the disallowance of large expenditures may also reduce return on utility investments to such an extent that utilities are regarded by the financial community as high risks, forcing their cost of capital to rise and increasing rates.

It is even conceivable that disallowances could be so large as to induce bankruptcy. The regulator who thinks that is the utility's problem should think again. Conventional financial wisdom suggests that debt reorganization would probably drive up capital costs and, consequently, customers' rates.

Utility customers also may be harmed by the effects of large disallowances on technological advancement. New technologies may develop that are environmentally and economically superior to existing ones. However, because some regulators regard new technology as a "higher risk" and hold utility management to a higher standard of performance, old rather than new technologies are likely to be used for expanding service. Thus, political action designed to protect consumers may deprive them of the benefits of technological innovation.

Making Sense Out of Prudence

Where do we go from here? Utilities and regulators must take action individually and in concert.

Utilities must recognize that prudence and other theories for evaluating utility management are here to stay. It makes little difference whether the issue is construction, excess capacity, or operating matters such as outages or backfitting. Any action or inaction which results in an expenditure of money may be subject to prudence or some other kind of regulatory review.

Utilities must develop management systems to deal with the problem. They must assess current decisionmaking processes for investments. Most processes will need to be revised to assure proper data input, development and evaluation of alternatives, and documentation of the judgment. In addition, most utilities will need to establish an infrastructure for management of the process. Such an organization

could take many forms but ultimately will perform prudence quality assurance.

Regulators also need to take action. Terms and standards must be more clearly defined. Where terms and standards are not clearly defined, regulators are at least partially responsible for any adjudged mismanagement.

Regulators need to think more carefully about how to limit the influence of politics in the exercise of judicial power. The National Association of Regulatory Utility Commissioners should address this issue. Moreover, consideration should be given to the potential adverse effects of large disallowances on electricity customers. Perhaps formulas can be developed to assure that the process maintains a better balance.

Utilities and regulators must work together to improve the entire system. Although the cases currently in the pipeline probably must endure the pain of trying to establish prudence by reconstructing the past, target standards should be established and take the place of retrospective analyses.

Target standards will enhance utility certainty in the process. They should also reduce risks associated with construction, operation, regulation, and political change. Reduction in risk could also mean holding down or reducing customers' costs.

Target standards could also provide a yardstick for regulators to measure the quality of investment decisions as they are made. This would obviate the use of hindsight for which so many regulators are currently criticized.

Certainly, a wide range of actions could be taken. What is suggested here is intended to provoke thought rather than be definitive.

The key point is that current applications of the prudence theory clearly establish a need for change. Effective change only can be realized if utilities and regulators reassess their respective positions and work together to define terms and achieve practical standards for prudence.

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The Greenhouse Effect

Is the earth's climate going haywire?

Fossil fuel combustion and other activities of the industrial age are adding carbon dioxide and a variety of "trace gases" to the atmosphere in quantities that may be altering climate on a global scale.

The change is taking place slowly, if at all; so far, the evidence is uncertain. But if this apparent alteration is real, effects could emerge unmistakably within the next 10 to 30 years.

The eventual consequences are impossible to predict confidently at present. They might include a warmer, drier climate and a slow rise in sea level that could gradually encroach on today's coastlines. Some areas could feel more intense changes than others, with varying impacts. Polar regions might warm; forests might grow or vanish; crops might flourish in balmier weather or shrivel in scorching drought.

The electric utility industry, among many others, could be seriously challenged in more ways than one.

Twenty years ago, the "greenhouse effect" was only the subject of speculation among a few scientists. Today, as evidence for it accumulates, the greenhouse issue is debated not only among scientists, but also in federal government reports, Congressional hearings, and major newspapers and magazines. It is being taken seriously.

The greenhouse effect takes its name from comparison with the growing of plants in glass-enclosed greenhouses, using a simple form of solar heating: the glass lets sunlight in, warming the floor and other objects inside, which in turn warm the air around them; but the glass prevents that warm air from escaping, so the temperature inside the greenhouse rises to a higher equilibrium level.

The atmospheric greenhouse effect works a little differently but has a similar effect. Carbon dioxide, water vapor, and ozone, all naturally present in the atmosphere, and some gases added by mankind in smaller amounts—trace gases—let sunlight warm the earth, but make it harder for the earth to reradiate all of that heat to outer space. Instead, these gases warm the layer of air near the earth's surface.

Natural greenhouse gases make life on earth possible. Without them, the earth's average surface temperature would be a freezing zero degrees Fahrenheit instead of the moderate 60 degrees F. that it is.

Because of solar radiation cycles, volcanic eruptions, and other factors, the average global temperature varies slightly over time—perhaps only a degree or two either way over the last several hundred years—but that's enough to make the difference, in temperate zones, between mild and harsh winters and summers.

The Human Touch

Since the mid-19th century, humanity has destroyed large forest areas and has burned large quantities of fossil (carbon-based) fuels, releasing large amounts of carbon dioxide (CO_2) into the atmosphere. As a result, the world already seems to be running a slight fever.

Around 1860, early in the industrial revolution, society was putting an estimated 100 million tons of carbon, a relatively small amount, into the atmosphere each year in the form of CO_2 from burning fossil fuels. It took about 85 years for those emissions to surpass one billion tons of carbon per year. After World War II, however, CO_2 emissions rose sharply: in only 35 years, they soared to more than five billion tons of carbon per year. That sharp increase alarmed climate scientists and started them trying to calculate the future effects.

Some of What Goes Up Must Come Down

Such calculations are not simple. Not all of the CO_2 put into the atmosphere stays there. The ocean absorbs large amounts of CO_2. Trees and other plant life also absorb CO_2 from the air to support their growth. That's why the massive destruction of forests contributes to a greenhouse effect. On the other hand, increasing CO_2 nourishes more vegetation, which takes more CO_2 back out of the atmosphere, slowing its accumulation through a kind of "feedback" loop.

So, while human activity adds CO_2 to the atmosphere, natural processes subtract some of it.

It is estimated that of all the CO_2 put into the air by fuel-burning, about 58 percent stays there—give or take a lot: the estimates range anywhere from 30 to 80 percent.

What counts most in measuring atmospheric carbon dioxide is its concentration as a proportion of the

Dr. Jae Edmonds is a technical leader of economic programs at Battelle Pacific Northwest Laboratories, Washington, DC. Dr. Michael Farrell is director of the carbon dioxide information and analysis and research program at Oak Ridge National Laboratory. Dr. Michael Scott is a senior research economist at Battelle Pacific Northwest Laboratories, Richland, Wash. Dr. Boyd Strain is professor of botany and director of the phytotron at Duke University.

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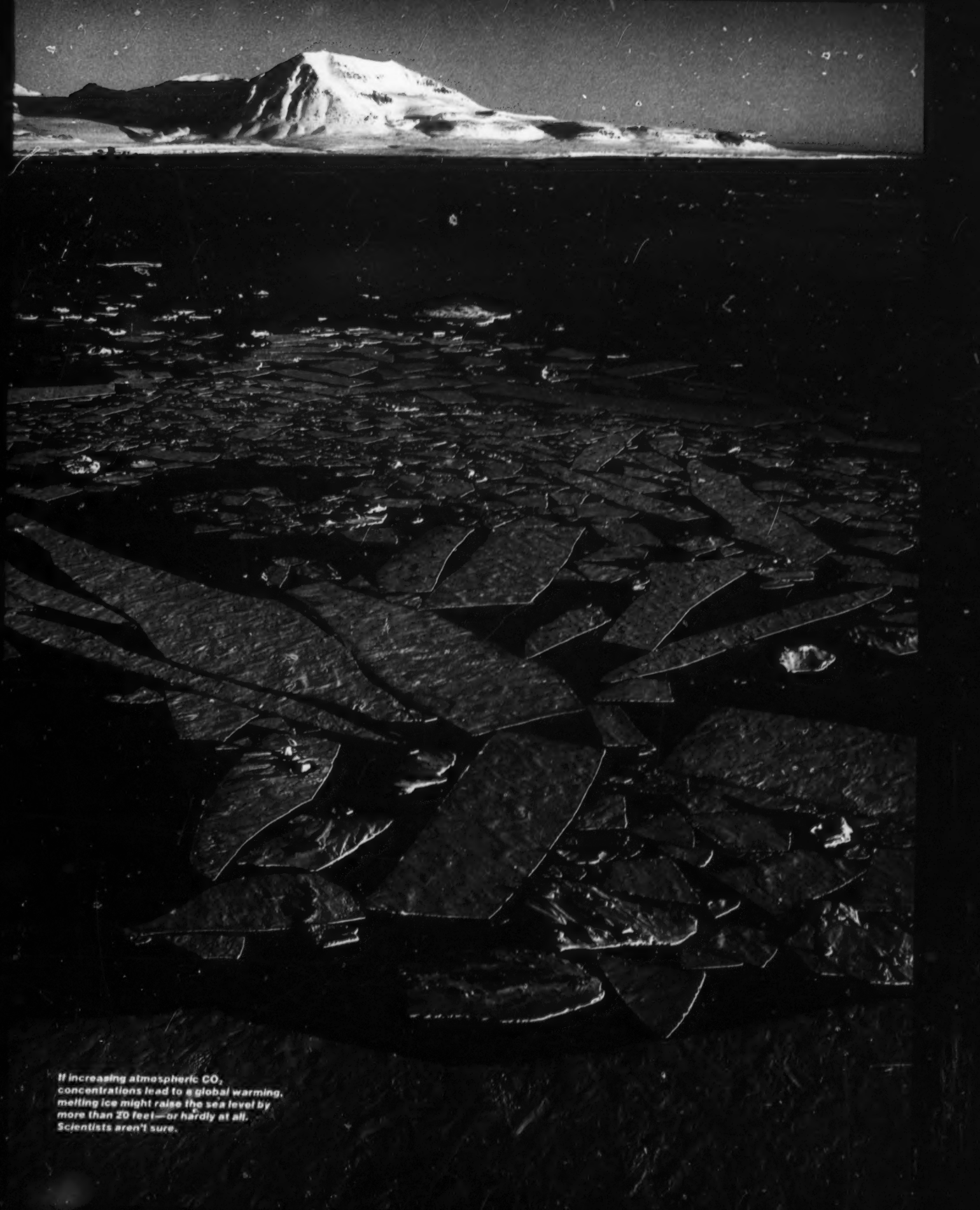

If increasing atmospheric CO_2 concentrations lead to a global warming, melting ice might raise the sea level by more than 20 feet—or hardly at all. Scientists aren't sure.

atmosphere. That proportion is in fact very small; it's measured not in such bulky terms as percentages but in "parts per million."

Since 1958, airborne CO_2 concentrations have been measured regularly. Scientists have derived a good idea of earlier CO_2 levels from examination of tree rings and analysis of glacial ice.

Over a hundred million years ago, atmospheric CO_2 concentrations were probably as high as 1,000 to 5,000 parts per million (ppm)—far higher than today. Prehistoric plants flourished on all that CO_2, storing it away in roots and stalks and leaves, removing it from the atmosphere. CO_2 concentrations dropped as plants gradually died and laid down carbon in the fossil fuel deposits that we now mine and burn.

About one million years ago, CO_2 concentrations stabilized, oscillating between 200 and 300 ppm, perhaps in association with the ice ages.

What Came Down Is Heading Back Up

In 1800, the atmospheric CO_2 concentration was around 270 parts per million. Since then, however, humanity has been burning fossil fuels and releasing carbon back into the air at a rate much faster than nature locked it up. As of 1984, the airborne CO_2 concentration had climbed to about 345 ppm.

Between 1945 and 1979, fossil fuel burning worldwide grew at a rapid annual rate of about 4.5 percent; at that pace, the concentration of carbon dioxide would have doubled by the early years of the next century—well within the lifetimes of most of us. That pace was not maintained, however. In reaction to the sharp fuel price increases of the 1970s and other economic and industrial factors, fossil fuel burning seems to have levelled off. But even at "zero growth," this continued fuel burning emits a steady stream of CO_2.

It seems highly likely that CO_2 concentrations will exceed 400 parts per million before the year 2025—a level last seen more than a million years ago.

The best current estimates of future release rates foresee concentrations reaching 600 parts per million

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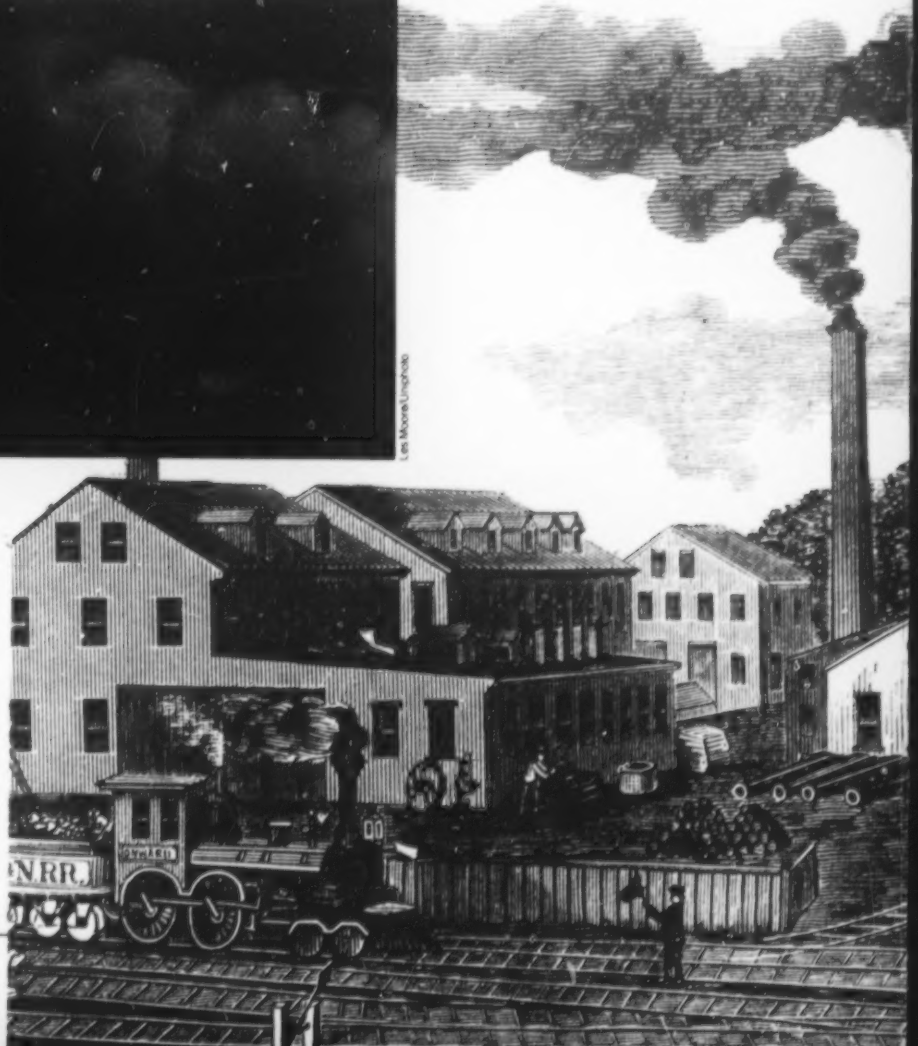

During the mid-1800s, fossil-fuel burning released about 100 million tons of carbon into the atmosphere yearly; today the annual total exceeds 5 billion tons.

some time later than the middle of the next century, in the absence of specific programs to control emissions.

But CO_2 is not the only problem. Methane, nitrous oxide, ozone, and chlorofluorocarbons (CFCs), all released or influenced by human activities, are also potent greenhouse gases which directly increase atmospheric heat retention. And they may be enhanced by still other gases that play an indirect role. Carbon monoxide, for example, is

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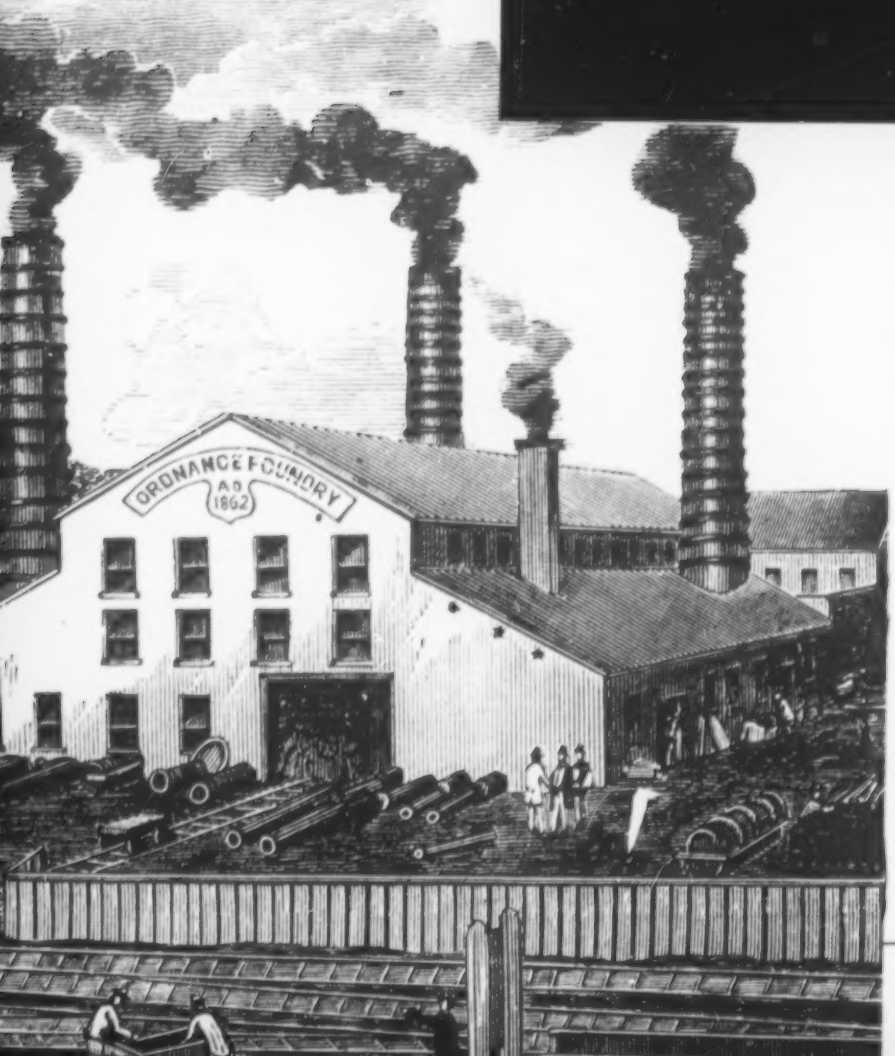
In a warmer, drier world, the geography of agriculture could shift dramatically.



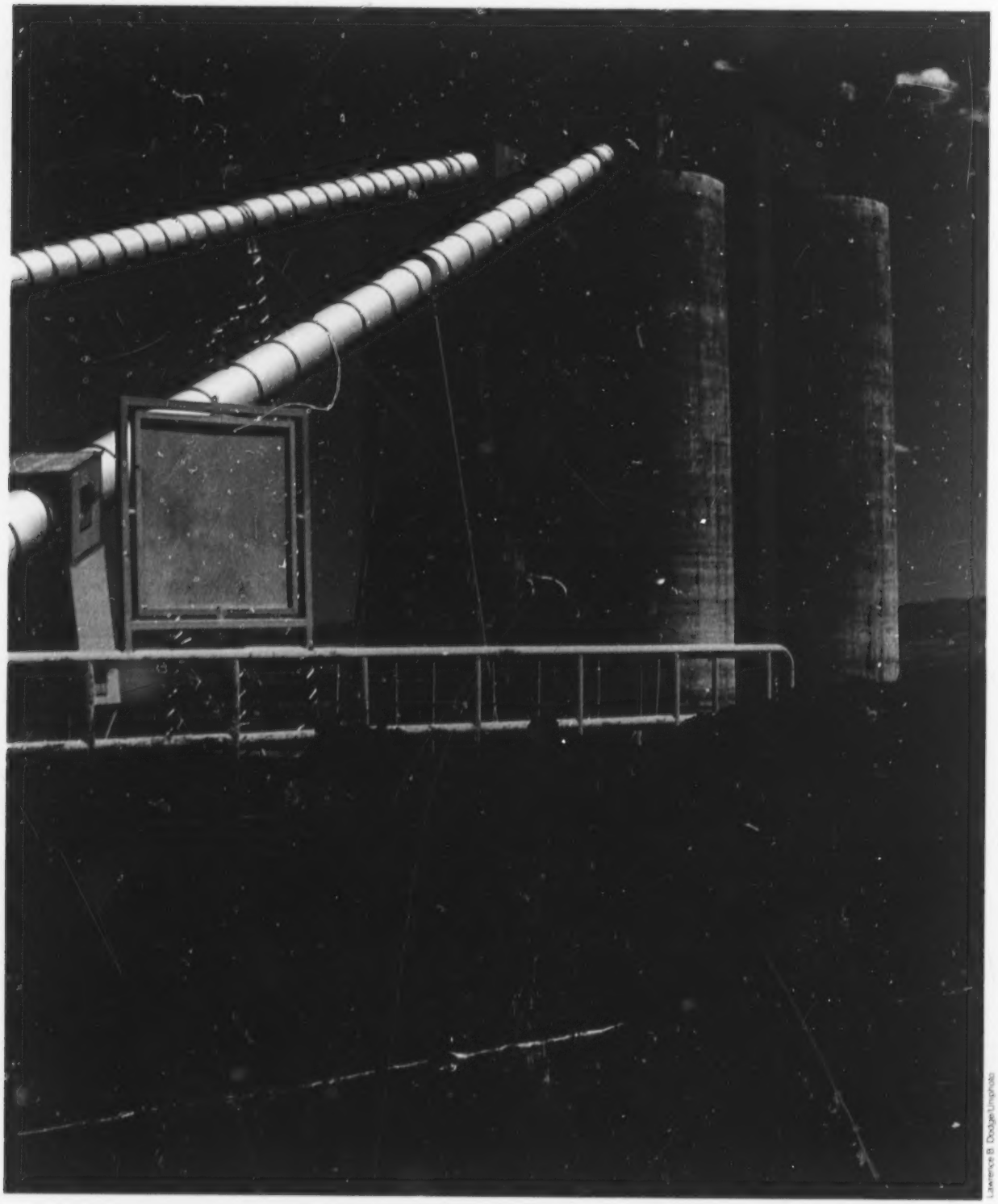
not a greenhouse gas. However, it competes chemically with methane to react with hydroxyl radicals—hydrogen-oxygen ions in the atmosphere—which would otherwise break down the methane. An increase of carbon monoxide emissions could increase methane concentrations.

The concentrations of these other gases are even smaller than that of CO_2: they are measured in parts per *b*illion, not million, and so are found only in trace quantities. But they may increase the greenhouse effect of CO_2 by as much as 50 to 100 percent.

What Do We Know?

What is the significance of these estimates for the future global climate? At present, only educated guesses are possible.

History gives us a small and uncertain hint: while airborne CO_2



Lawrence B. Dodge/Lmphoto

and the trace greenhouse gases have been rising, so has the observed temperature. The global average surface air temperature has apparently increased by nearly one degree Fahrenheit over the last 150 years.

This rise corresponds roughly with the rise in CO_2 but it does not show as smooth a trend. And one degree F. is well within natural fluctuations. Such natural influences could account for the entire temperature increase—or, working in the other direction, could be moderating and partially masking an increase that would otherwise be even higher. We are not sure whether a natural temperature change is currently in progress or, if it is, which way it is moving.

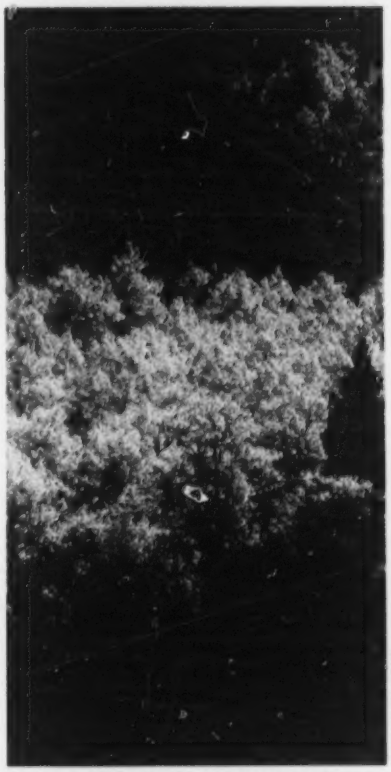
The anticipated CO_2 increase to 400 parts per million by 2025, magnified by trace gas effects, could raise the average temperature another degree or more. At that level, the global average temperature would be pressing the values last reached about 6,000 years ago.

The most recent computer simulations suggest that once a new equilibrium climate is reached, a CO_2 concentration of 600 parts per million would raise the mean global temperature about 3 to 8 degrees Fahrenheit higher than it was in the 19th century. However, the simulations may be missing some moderating feedback effects. Trace gas effects might enlarge that increase to anywhere from 4 to 12 degrees Fahrenheit. Such temperature increases, even in the lower range, would leave little doubt about the reality of the warming trend and humanity's responsibility for it.

But a wait-and-see approach might be short-sighted. It is not at all clear yet just how closely increases in atmospheric temperature follow increases in greenhouse gases. Some scientists suggest that the capacity of the oceans to absorb heat could delay for many years the full impact of a greenhouse effect on land and air temperatures.

One implication of that argument is that the global temperature rise over the past 150 years may be just the start of a much larger increase, irreversibly ordained by the stuff we've already put into the air. That argument also implies that if we wait until we're sure that we've caused a real problem, the problem may already be much larger than we realize.

Without specific programs to control emissions, atmospheric CO_2 concentrations probably will increase 16 percent by the year 2025.



Ken Lucas/Unicorn

Forest boundaries could shift in response to the changing climate.

Living in a Warmer World

If increased greenhouse gases do warm the planet by a few degrees over the next century or so, what kind of world would our grandchildren and their descendants face?

It would, of course, be warmer. But it could also be a slightly drier place on the average even though the overall rates of evaporation and precipitation might increase—warm air can hold more moisture than cool air without letting it fall as precipitation.

At the same time, however, vegetation growth might increase, fertilized by the additional CO_2; and, with high CO_2, many plants can get by with less water. This effect might not be entirely beneficial; increased growth might deplete croplands of their nutrients faster and make weed control more difficult.

A global warming might also raise the level of the oceans, because of thermal sea expansion and because of the melting of some polar ice. Floating ice would not raise sea level as it melts: it takes up the same subsurface volume either way. But land-borne ice would; and the ice-laden Antarctic continent is the major potential source.

Get the Ark Ready?

Sea level rise, if it occurs at all, is currently expected to happen slowly over many centuries. An increase of one-to-five feet could possibly occur over the next century.

But more dramatic scenarios cannot be excluded. The Ross ice shelf is now frozen to an edge of the Antarctic land mass, acting as a gigantic cork bottling up continental ice streams on land. If the greenhouse effect warms the sea, it could melt the underside of the Ross ice shelf, eventually floating it off its continental moorings. The cork would be out of the bottle, opening the way for land ice to advance into the ocean, and thus raising sea level by 16 to 23 feet—not instantly, but over a period of perhaps 200 to 500 years. Coastal communities might have to retreat and build dikes.

That possibility has been featured in various popular accounts of the greenhouse issue. But it may not happen after all.

Sea level has, in fact, risen by something less than one foot over the past 100 years, as atmospheric CO_2 and temperature have increased. That rise should be explained, in greenhouse theory, by thermal expansion of the oceans and by glacial ice meltings; but existing models have been unable to explain observed changes in sea level with these mechanisms.

While relatively small alpine glaciers have been melting, the massive ice sheet of Antarctica seems to be thickening so that on balance ice seems to be building up instead of dwindling. We are left with an enigma. Science is at a loss to explain fully the sea's historic rise, and all forays into the future start from a somewhat shaky foundation.

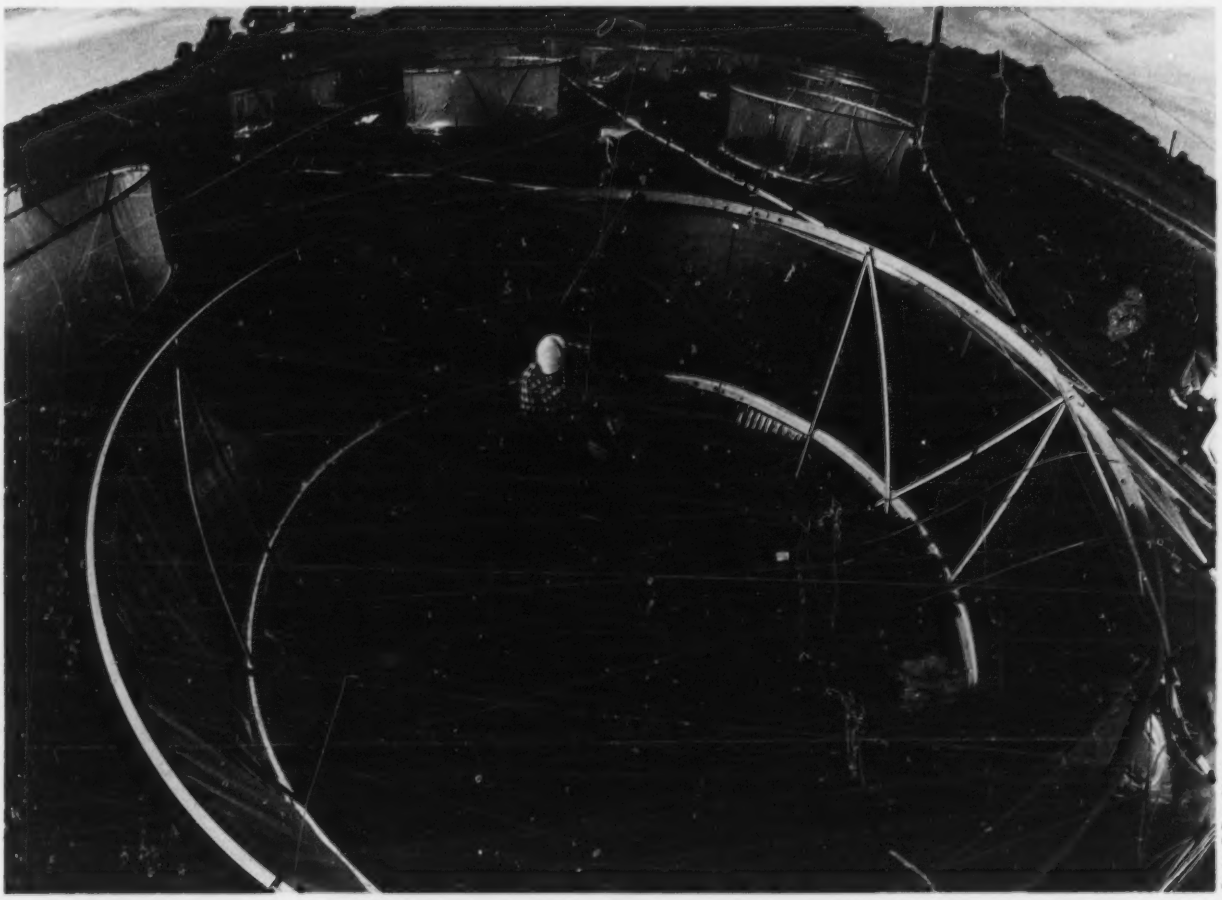
If climate change were to increase precipitation and ice buildup in Antarctica, then sea level rise, instead of being dramatic, could be a minor consequence occurring over thousands of years. Neither extreme is currently anticipated; the ark can remain in drydock.

What Happens Where

Global estimates of greenhouse effects, however, scarcely begin to convey the complexity of the potential problems. The effects would not be distributed evenly throughout the world.

Current computer models show climate change to be more extreme at the poles than at the equator, and most researchers feel that ecological responses will also be more pronounced in the polar and temperate regions than in the tropics. More specific predictions are impossible at this time. The boreal (northern coniferous) forests of North America could disappear and be replaced by grasslands, or they could shift geographic boundaries slightly, or

Scientists are studying the impact of increased concentrations of air-borne CO_2 on plant growth.



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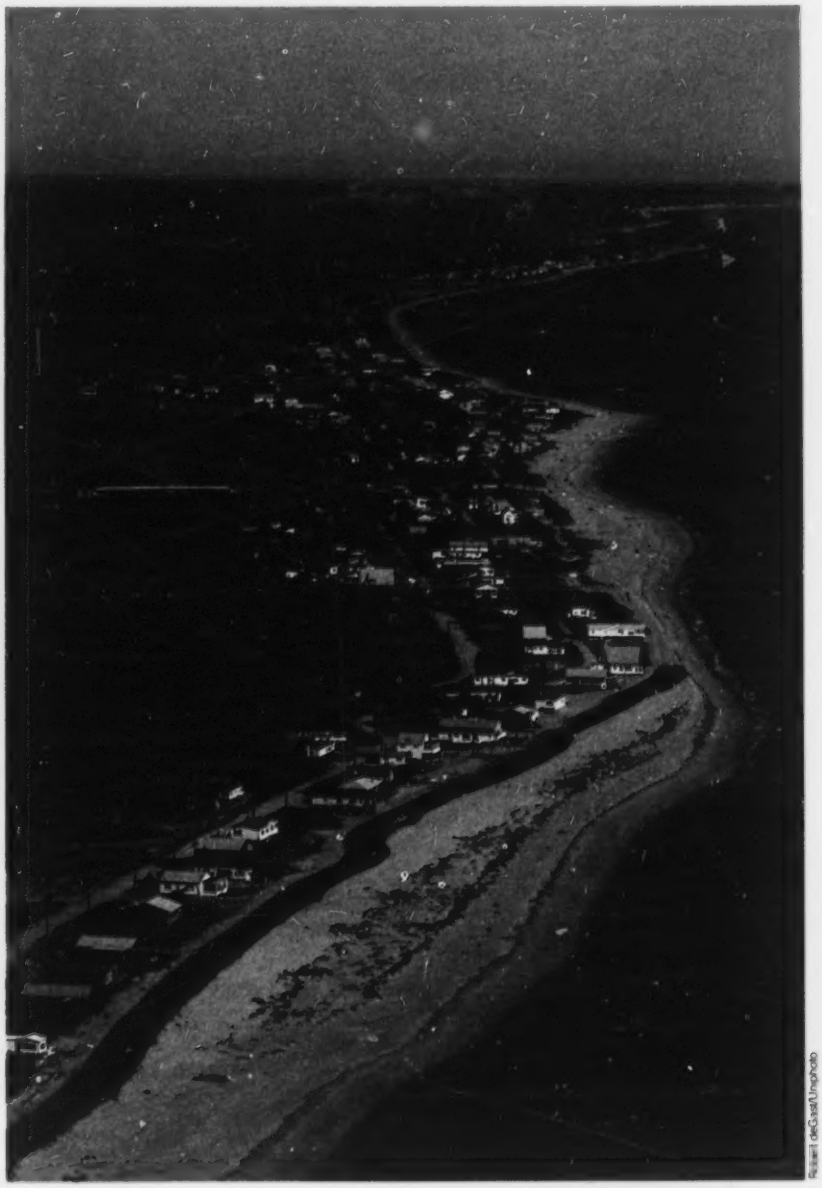

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The greenhouse effect could force coastal communities to retreat if the sea level rises.

they could be replaced with hardwood forests.

In an altered climate, water may become more plentiful in some regions and scarcer in others. Precipitation may occur at different times and in different places than it does now. In some places, deserts may begin to support green life. In others, once-fertile soils may turn barren. New extremes of heat and desiccation could be experienced in some agricultural areas, and time-honored counter-measures may no longer work.

Such inequalities in the effects may prove to be one of the most serious obstacles to preventing them. Since the atmosphere is shared worldwide, no nation acting alone can prevent the greenhouse effect. But some regions might benefit from climate change, while others might be harmed. Unless the countries emitting large shares of the greenhouse gases are the same countries suffering the most harmful consequences, there may be little hope of reaching a political solution.

Problematical Solutions

If the greenhouse effect is shown to be a real threat to human society, and if nations could agree to cooperate, what could be done? Options fall into three categories: reduce our emissions of greenhouse gases, capture carbon before or after combustion, or adapt to an altered world. The first two choices could present serious direct problems for industry. The latter could present serious indirect problems for industry.

CO_2 is the natural product of burning oil, gas, coal, wood, or any other carbon-based fuel. To curtail CO_2 emissions, we might have to curtail the use of these fuels, which are so vital to human society today.

At large fuel-burning facilities like fossil-fueled electric power plants, it might be feasible to capture the waste-gas CO_2 after combustion; technically feasible methods already exist. But this would do no good unless the captured CO_2 could be disposed of, permanently, where it could not escape to the atmosphere. And where might this be? Some people suggest that captured CO_2 could be released at the bottom of the sea and would stay there; others suggest pumping it into natural underground salt domes. Such suggestions have not been tested, so no one knows for sure whether they would work.

Other greenhouse gases present their own control problems. Of the methane emissions due to human activities, cattle production causes about 30 to 40 percent (methane is produced by digestive processes); natural gas activities and deep coal

mining release about 20 to 30 percent; and a roughly equal amount comes from rice cultivation.

Chlorofluorocarbons (CFCs) are a special case. They are entirely man-made; they not only contribute to the greenhouse effect, but they also destroy the stratospheric ozone layer which partially shields us from harmful ultraviolet solar radiation; and they can be controlled. Some years ago the United States banned the use of CFCs as aerosol spray propellants; proposed international accords on CFCs are currently under negotiation.

The Challenge to Electric Utilities

The emergence of a real greenhouse problem would have serious impacts on the electricity utility industry, among others.

Worldwide, electric utilities accounted for about 30 percent of global CO_2 release in 1975; U.S. utilities alone emitted some 10 percent of the total. In addition, coal-burning by power plants is the overwhelming source of man-made nitrous oxide emissions. Electric utilities and other industrial sources might well be required to curtail fossil fuel combustion and/or capture carbon dioxide from waste gases and dispose of it.

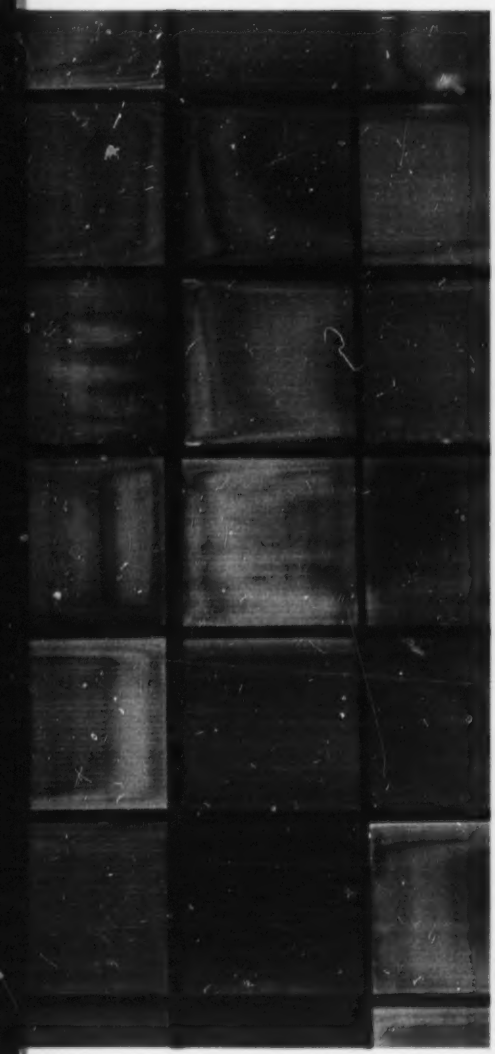
Non-carbon-combustion energy alternatives are available, including nuclear fission power (and perhaps, some day, nuclear fusion), hydroelectric, solar, geothermal and wind power, as well as energy conservation measures. But climate-related sources like hydro, solar, and wind power could themselves be altered by greenhouse effects.

Greenhouse-induced climate changes would also challenge electric utilities by altering both seasonal and geographic load patterns as the needs for air conditioning and refrigeration grow, and agricultural, economic, and transportation activities relocate. Demand for electricity from power plants where CO_2 emissions could be controlled, might even rise to replace fossil-fueled energy in other sectors where emission control is impractical, such as homes and vehicles.

What Do We Do Next?

Information about the timing and magnitude of climate change and its direct and indirect effects remains fuzzy. But unless nations intervene to change the course of such activities as fossil fuel use and CFC production, the continued buildup of CO_2 and other trace gases in the atmosphere is inevitable. Research has not removed the possibility of major and adverse consequences.

Nonetheless, there is general (but not unanimous) agreement among researchers and members of national and international policy communities that the time is not yet ripe to establish policies in the area of CO_2 and climate change. There



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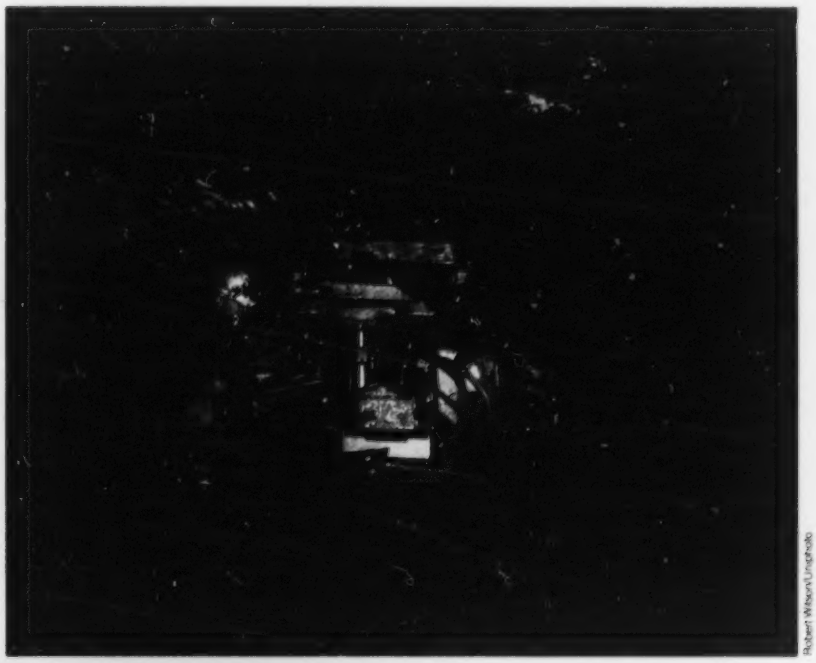

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Solar-powered alternatives to fossil fuels could themselves be affected by the greenhouse effect.

is insufficient information on future emissions, biological effects, climate change mechanics, and resource consequences.

At this point, there appears to be at least a five-to-ten-year window of opportunity in which to conduct further research on CO_2 and the greenhouse issue—that is, we can postpone decisions at least that long without fear of damaging the world's climate beyond repair—particularly if international initiatives currently underway to control CFC emissions are successful. What could we learn in the next five or ten years that might help? Quite a bit.

We will have five to ten years more of systematic observation of the climate and of CO_2 and the trace gases. Regular CO_2 monitoring has been under way only since 1958, and trace gas monitoring has barely begun.

We may gain more understanding of the sources of trace gases, their reactions in the atmosphere, and their common links.

We may study how the greenhouse climate would influence biological reactions and how they, in turn, may influence it.

We may develop better forecasts of future fuel use and CO_2 emissions in the light of demographics, technology change, and trends in labor productivity.

We need to develop better climate models. Present mathematical models of climate strain the capacity of supercomputers. And yet these climate models are still in an elementary state of evolution. They are not yet able to reproduce present climates across geographic

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boundaries smaller than a continent, satisfactorily and consistently. They can't deal adequately with the interaction between the atmosphere and the oceans. They are unable to represent accurately the relationship between clouds and climate. In five to ten years, computers and climate models should improve.

The funds available for such research are not enormous for such a complex global problem—perhaps no more than about $25 million a year is assigned to it by U.S. federal agencies. (The estimate is elusive: greenhouse research benefits indirectly and to varying degrees from research funded specifically for other purposes.)

So all the research of the next decade may not provide enough information to support sound decisions; it may serve only to establish what additional research is needed.

But eventually we will have to come to some kind of balancing: must we slow down emissions of the greenhouse gases or not? We can't wait forever to decide.

Note

Perhaps the most complete discussion of the relationship between carbon dioxide, energy, and the planet can be found in a compendium of six volumes of research recently released by the U.S. Department of Energy. The six volumes are known collectively as the "state-of-the-art reports." The titles are:

Atmospheric Carbon Dioxide and the Global Carbon Cycle (1985), J. Trabalka (ed.), DOE/ER-0239.

Detecting the Climatic Effects of Increasing Carbon Dioxide (1985), M. MacCracken and F. Luther (eds.), DOE/ER-0235.

Projecting the Climatic Effects of Increasing Carbon Dioxide (1985), M. MacCracken and F. Luther (eds.), DOE/ER-0237.

Direct Effects of Increasing Carbon Dioxide on Vegetation (1985), B. Strain and J. Cure (eds.), DOE/ER-0238.

Glaciers, Ice Sheets, and Sea Land: Effect of a CO_2-Induced Climate Change, DOE/ER/60235-1.

Characterization of Information Requirements for Studies of CO_2 Effects: Water Resources, Agriculture, Fisheries, Forests and Human Health (1985), M. White (ed.), DOE/ER-0236.

These reports are available from the Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tennessee 37831.

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When emergencies strike, restoring service is only one part of a utility's job.

It's a Disaster

If a hurricane hits or a gas turbine explodes, emergency planners must know how to deal with the public, the media, and external services.

Since the water wheel churned out the first kilowatt-hours, electric utilities have been ready for emergencies. If the line broke, or floating debris fouled the wheel, or a fault showed up in the generator, service came to a halt. Customers were without lights, and emergency restorations had to be made as quickly as possible.

Ways of handling power emergencies caused by major storms, equipment failures, natural gas explosions, and fuel supply interruptions have been upgraded and refined through the years. How quickly utility teams can mobilize even under the most arduous conditions is a matter of pride and professionalism.

With very few exceptions, the system operations side of utility companies has responded in excellent fashion to crisis conditions. However, attention is turning now to improving the quality of coordination with outside organizations and communications with the public.

Meeting of Minds

In October 1986, the New York Power Pool convened a workshop on non-nuclear emergency response and communications. John E. Mack III, president and chief executive officer, Central Hudson Gas & Electric Corporation, told the 106 attendees: "The problems that have adversely affected utilities and public agencies do not stem from a lack of response to these emergencies, but rather from a lack of public understanding of the quality of the job we actually do. It is therefore a key objective of this workshop for more effective coordination and communication, not only within our organizations, but on an industry-wide basis, and with local and state emergency planning and response organizations, and keyed with the general public itself."

One case examined was Long Island Lighting Company's response to the devastation of Hurricane Gloria in 1985. Lynne D. Abraham, LILCO's vice president of public affairs, said the violent storm knocked out service to 750,000 households, 80 percent of LILCO's customers. Before leaving Long Island, Gloria's winds splintered 12,000 utility poles, downed millions of feet of primary wire, destroyed nearly 700 transformers, knocked out 85 substations, and caused 500 distribution lockouts with each one affecting an entire community.

Governor Mario Cuomo called Hurricane Gloria "the worst natural disaster ever to strike New York State." Bringing power back became one of the largest restoration efforts on record for the electric utility industry. Close to 2,500 workers from 35 utilities joined with LILCO's 1,500 field forces. Noted Abraham, "They put together in days what it had taken almost a century to build."

While the massive restoration project was underway, LILCO's customer service switchboards were inundated with more than 580,000 phone calls over an 11-day period. In the same time, the public affairs staff handled 300 media inquiries.

Even while crews were rebuilding the LILCO system, several government reviews of the utility's performance began. These reviews were conducted by a Governor's Task Force, by the New York Public Service Commission, and by Suffolk County.

One member of the Governor's Task Force on hand at the workshop was James M. Cunningham, senior vice president for public affairs for the New York Power Authority. What did the Governor's Task Force look at? According to Cunningham, "We wanted to find out if there was an emergency plan in existence. We found out there was. Was this plan adequate? For the most part, we concluded it was. We wanted to find out whether the utility was adhering to the plan; was it following the letter of the plan? We found out, for the most part, the utility was."

Yet overall emergency planning, observed Cunningham, lacked coordination between the utility, the county, and the state. He cited examples involving portable generators, dry ice distribution, and interagency communication.

As a Long Island resident, Cunningham gave this personal assessment of public communications after the storm: "I can tell you that one of the most difficult things the folks in Long Island had to deal with was this notion that they could not get specific information as to when their lights were going back on. I can't drive that point home hard enough. And very simply, what it comes down to is coordination between communications and

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Jeffrey W. Myers/Unigraphic

operations. I realize that it is a very difficult thing, but it can be done. Let's never underestimate the importance of providing our consumers with specific information."

LILCO also carried out its own internal critique of its own performance, a procedure recommended for every utility. Then the LILCO Board of Directors established a Restoration Review Panel to consider the recommendations from all internal and external sources and to "carry out the changes."

Commenting on the changes, LILCO's Abraham emphasized that "the cornerstone of the storm restoration improvement plan was the establishment of the Restoration News Center, called the RNC." At the RNC, patterned after the joint news centers near nuclear plants, reporters can get up-to-the-minute storm information not only from LILCO, but also from state, county, and municipal sources.

Other improvements implemented by the utility included adding 100 apprentice lineworkers to bolster field forces, beefing up storm repair supply inventories by 20 percent, doubling the number of available storm kits for visiting crews, using mobile storerooms to directly support field forces, and improving communications with municipal public works and highway departments. Drills have been held to test LILCO's response to ice storms and hurricanes and the company's plans for outside agencies like the Red Cross to participate in the RNC.

John Bowden/Uniphoto

The speed with which they respond to disasters like storm damage and fires is a source of pride for utility employees.

The Public Must Know

When a disaster strikes, most utilities can mobilize the rapid response needed from operating staffs to isolate the trouble, to minimize injury and damage, and to attempt to restore normal power service. This focus remains a top priority. But, today's Americans are accustomed to high-speed communications; they demand timely information when something goes wrong from the "people in charge," whether they represent a utility, a government agency, or a business organization. The New York Power Pool workshop stressed this point repeatedly and urged greater coordination between operations and communications staffs during a crisis.

Federal and state regulators, too, are concerned about public communication. Dyke Farrow, chief of power systems operations at the New York Public Service Commission, had this to tell the workshop group: "Based on our experience since Gloria, the feature of storm plans we feel most important is, first and foremost, provision for ef-

fective communication with the public, the media, and government agencies. This is a critical and often unappreciated aspect of storm recovery. Customer understanding and appreciation of the utility effort is as important as the quality of the effort itself. . . . The point is, your good work will not be appreciated if you don't do a good job of keeping the public informed."

In most cases, major disaster shatters the normal routines of customers and the general public. Their immediate questions have to do with the restoration of service, their return to evacuated neighborhoods, and the elimination of hazardous or unsafe conditions. Ironically, during the initial stages of an emergency when these questions are asked, reliable information is scarce. Damage assessment is still underway, casualty information is sketchy, internal communications are not fully established, and emergency personnel are not all in place.

At this point, the public deserves assurances that an emergency plan is being implemented and that trained personnel are responding in accordance with procedures. As soon as details become available, particularly those that answer immediate questions, they should be released quickly through the news media. Crisis managers must quickly and clearly establish a steady flow of timely and reliable official information, including restoration priorities. The tone and manner of the spokesperson must always reflect the company's sincere concern for the plight of the public.

The Media's Role

As the workshop recognized, emergency decisionmakers must understand that the news media has a legitimate interest in and responsi-

Robert Diamond/Uniphoto

The media can provide utilities with the fastest and most cost-effective way of communicating with the public during emergencies.

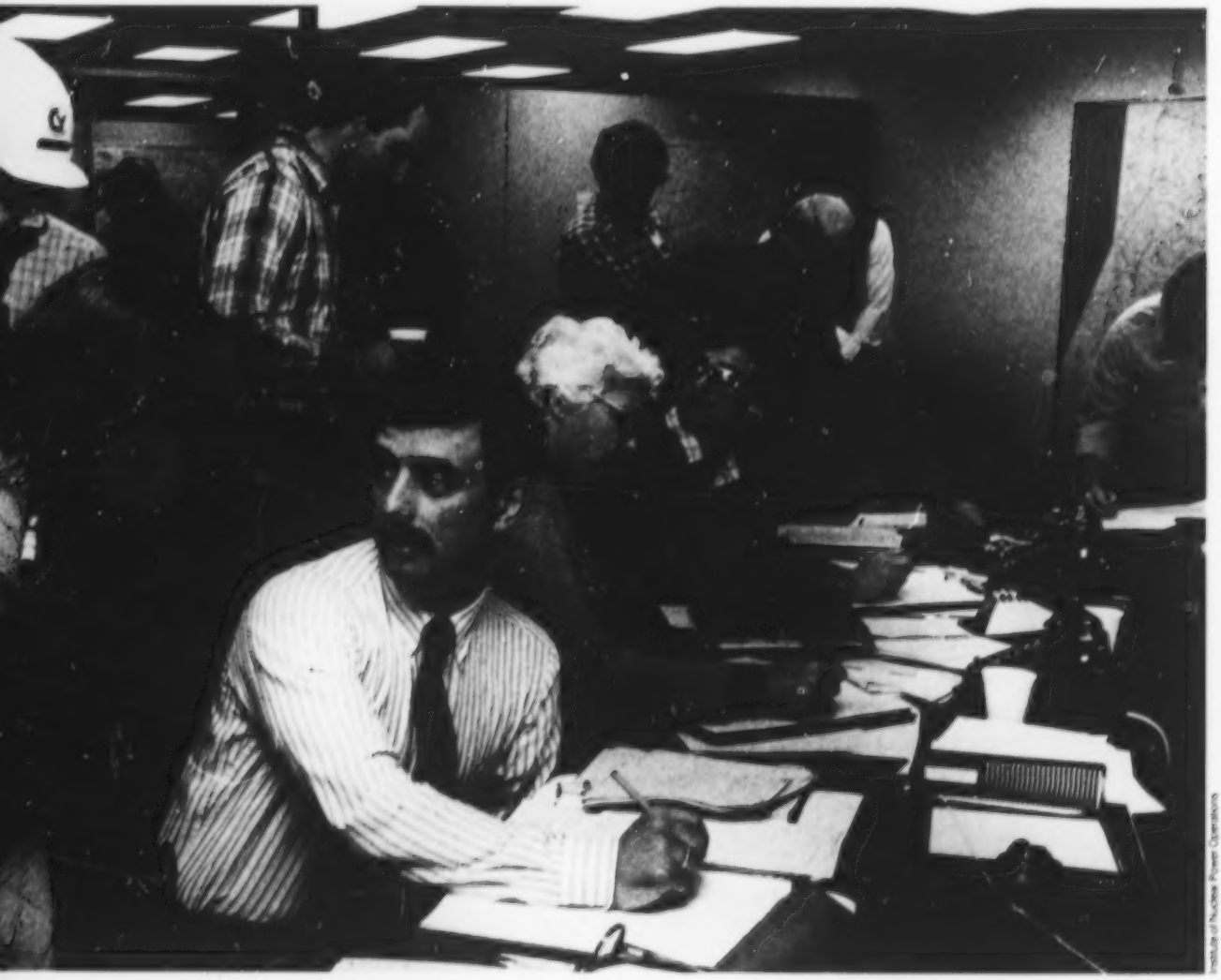
Jane Cook/Fotomedia Inc.

bility for keeping the public informed during disasters. In fact, the media, particularly radio and television, provide utilities and other agencies with the fastest and most cost-effective means of reaching large numbers of customers; the media is an extension of the emergency public information staff. Not only can the media inform customers, but timely messages from the utility will significantly reduce the predictably large volume of telephone calls to customer service switchboards.

But the news media will not act solely as a communications pipeline for a utility. They will seek much more information about the disaster, which trained utility spokespersons should be prepared to provide within reason. In cooperation with other response agencies, the establishment of a joint news center, whether in a convenient building or adjacent to the scene of the disaster, is highly recommended.

Representatives of the utility, local and state government, police and fire agencies, and community assistance groups should be available to brief the news media at this single location. The parties that would staff such a news center should drill together in advance to ensure coordination and cooperation.

The news media at various times will want to know about possible casualties, the scope and severity of property damage, cause of the disaster, description of rescue efforts, possible secondary emergencies, summary of events to date, and human interest stories, especially ones about heroic actions or delinquent behavior. These demands place a heavy burden on the emergency public information staff and require



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trained professionals who are fully aware of their responsibilities and restrictions.

The principal spokespersons for each organization should be trained adequately for this role and should have no other responsibilities during the emergency. The job requires a cool, articulate individual who can maintain his or her credibility under stress. Spokespersons, or their immediate support staff, also must have direct and instant access to the emergency manager. Trained backups also should be available.

With the prospect of hundreds of media telephone inquiries daily, plus squads of reporters crowding a joint news center, the public information staff must be ready. The media must understand that you are their best source of official information and that you will cooperate to the best of your ability. Try to respect deadlines and comply with reasonable requests. Treat all the media, whether local or national, equally. Don t cover up the facts or attempt to mislead. Release only approved information about casualties, damage, restoration time, or cost estimates.

When the scene of the emergency lies beyond the formal news center, the public information plan should include access control and responsibilities. Two perimeters should be established around the scene, the inner one to allow only emergency response personnel and equipment to enter. An outer perimeter is used to allow the news media to see the

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David M. Doody/Unocal

Proper planning and training—including drills with the media and others—are essential to the success of any emergency response program.

scene in accordance with safety restrictions and the requirements of those supervising emergency operations; John Wayne-type bravado must be discouraged. Media personnel must display some form of recognized credential to gain access. These and other ground rule requirements should be reviewed with local news media periodically. Such procedures often are routine for reporters familiar with fire and police operations.

Responsibility for securing the perimeters should be assigned in advance to local police agencies, utility security personnel, or a combination of both.

Disasters generate rumors that swirl about an affected community and occasionally among emergency workers. Steps should be taken to establish a rumor control center as part of any emergency plan, listing locations, phone numbers, and staffing responsibilities. This operation can be a joint function with local government to lessen utility personnel requirements. An effective means of reducing rumors is an internal system of communications to keep emergency workers informed by holding briefings and by frequently posting copies of new releases on bulletin boards.

Hard-copy news releases are a must for a disaster situation. While oral briefings and telephone responses are necessary, official information must appear in written news releases to ensure that all responses are consistent and that a formal record is available for any investigation that may follow.

Advance Training

Training in all aspects of emergency response is essential for the key players who will direct the effort. It can range from simple table-top ex-

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ercises to full-scale drills involving an entire organization. Training and drills ensure that the written plan is current and that it works. Remember that telephone numbers change as do equipment, radio frequencies, and names of the county emergency coordinators. Where some of these plans are assisted by computers, are the programs up-to-date and is there a backup system?

Training opportunities are also available outside the company. For example, utilities may exchange personnel to observe and critique a neighbor's drill while at the same time picking up some new ideas. Utilities should also inquire about training opportunities with state emergency management organizations, the Federal Emergency Management Agency, and colleges and universities. Of particular interest are courses in crisis management, planning, and coordination. The benefits of training with outside agencies can include improved performance and the establishment of important contacts in a nonstressful setting.

Utilities can perform a valuable public service to community organizations and customers by willingly sharing skills and experience in emergency planning. Such outreach programs already include conservation, safety, and other specialized areas. One example is the Niagara Mohawk Fire School, which has been training 300 volunteer and paid fire fighters annually for 27 years in battling electric and gas fires. Why not consider similar assistance in emergency planning for customers and local government? Similarily, these skills also can be used to strengthen ties with journalism and business schools on local campuses.

Lessons from Outside

The disasters of the 1980s—such as Bhopal, Air Florida, Amtrak, Tylenol, and the Challenger Space Shuttle—are disquieting testimony that an enterprise unlucky enough to be struck by calamity could pay a heavy price in lost public esteem, increased governmental and regulatory oversight, internal disruptions, and its financial position.

Utilities, with their diverse technology, high public profile, mandate to provide essential services, and propensity in recent years to be the target of controversy in the news media and by special interest groups, are unquestionably in a high-risk category. While not every crisis or disaster can be anticipated, corporate commitment and proper planning can aid in preventing, or at least lessening, the consequences.

Tax Reform: What To Look for in '87 and Beyond

Economists ponder the new tax code's impact.

On October 22, 1986, President Reagan signed into law the most comprehensive tax revision bill since 1924. The signing was greeted with a great deal of enthusiasm, as well as relief, by administration and Congressional supporters. Contrary to the assessment of numerous political pundits the bill was not dead on arrival, having passed both houses of Congress by substantial margins, nor had it been emasculated, surviving the arduous legislative process pretty much intact. For once it appeared that general interest had won a major victory over the special interest.

Despite the hoopla in Washington, many congressmen were receiving a much less favorable response from their constituents back home. Moreover, public opinion polls invariably reported a great deal of public confusion and anxiety concerning the consequences of the new tax bill. Now that a bill has finally passed, a review of the views and thoughts of some prominent economists may help to allay some of the uncertainty surrounding this historic legislation as well as to identify key indicators to watch as the economy responds to the new tax law.

Hailed as a "statue of liberty for America's entrepreneurs" by economist and writer George Gilder, the new tax bill has been given a favorable review by economists of such stature as Milton Friedman, Alan Blinder, Alan Greenspan, Robert Eisner, and Harvey Galper. This is not to suggest, however, that the bill is without its critics. In a recent business conference, Stanford economist Michael Boskin referred to the bill as "inherently unstable." Martin Feldstein, former chairman of the Council of the Economic Advisers, has repeatedly warned of the dire consequences resulting from the loss of investment tax incentives. Even supporters of the bill admit that the bill has some faults.

A Question of Fairness

With one exception, none of the economists reviewed in this article voiced opposition to the new tax bill on equity grounds. Princeton economist Alan Blinder referred to the new tax bill as a "great humanitarian gesture." Even economists who fault the new tax bill for a variety of other reasons readily agree that the new tax bill represents a much needed improvement in the area of fairness. In recent Congressional testimony, Jerry Jasinowski of the National Association of Manufacturers, touted fairness and equity as one of the few virtues of the new tax code. Economists from Wharton Econometrics described the new tax bill as perhaps the "most important piece of anti-poverty legislation in over a decade."

As a Nobel prize-winning economist, Dr. Friedman is as much recognized for his outspoken conservative ideology as he is for the theoretical and empirical work which made him famous within his profession. One would suspect that Dr. Friedman is opposed to income redistribution—and he is. However, Dr. Friedman is also opposed to governmental intrusion into the market place. Recognizing the political reality of ignoring the concerns of a significant percentage of voters, Dr. Friedman has long espoused the virtues of a flat income tax with sizable allowances for personal exemptions. In Dr. Friedman's view, such a tax affords low-to-moderate income taxpayers the freedom of choice and incentive so cherished by conservative economists. Whether for reasons of political expediency or by design, the lower tax rates and higher personal exemption provided under the new tax code dovetail with Dr. Friedman's conservative free market philosophy.

One economist has expressed a concern about equity. Martin Feldstein, former chairman of the President's Council of Economic Advisers, believes that the effect on poor and moderate income people may ultimately hinge on the market for rental housing. He compared the potential cost of a typical $50,000 apartment unit under the new and old tax code. Even allowing for an anticipated 1 percent decline in interest rates under the new tax bill, it was estimated that rents will have to rise by about $150 per month to offset the increase in net-of-tax construction costs under the new tax bill. Since this hidden cost swamps the meager reduction in tax liability for most poor households, he concludes that ". . . most low- and moderate-income renters will end up worse off than they would have been without the tax reform bill."

Although Dr. Feldstein's contention has been substantiated by the econometric forecasting firms DRI (Data Resources, Inc.) and Wharton Econometrics, his conclusion has not gone unchallenged. Michael Evans of Evans Economics, Inc., for example, maintains that an across-the-board reduction in

Mark Thomas is staff economist, Edison Electric Institute.

Bob Daemmrich/Uniphoto

The effect on government revenues—one of the key indicators to watch—will total "nearly $1 trillion over the next five years."

land prices will more than offset higher construction costs. In recent Congressional testimony, Alan Greenspan made a similar assessment, although he did not go so far as to predict a decline in the cost of multifamily housing. As is true with most other issues pertaining to the new tax law, the net effect on renters has yet to be resolved.

A Recession in 1987?

An issue repeatedly raised during the debate was that tax reform could precipitate a recession. Indeed, by the early summer of 1986 a consensus had emerged that the new tax bill would adversely affect short-term economic performance, although few economists anticipated a recession.

The prevailing pessimism has as much to do with the timing and composition of business and consumer spending as it does with the magnitude of these two economic aggregates. It is widely believed—although this too is a point of contention—that spending on nondurable goods will rise while capital and durable goods purchases and nonresidential construction will decline. In terms of total spending the gains and losses roughly cancel out. However, since the "losers" are expected to react faster than the "winners," the bill is expected to be mildly contractionary.

The major forecasting firms DRI, Wharton Econometrics, and Chase Econometrics support this consensus, predicting a short-term contractionary effect. Even the Council of Economic Advisers and the Treasury Department, principal supporters of the legislation, acknowledged that tax reform could have a short-run adverse effect.

While tax reform in and of itself is unlikely to cause a recession, its contractionary impact should not be considered in isolation. Other macroeconomic determinants such as the Gramm-Rudmann expenditure bill and the high level of public and private debt must also be taken into consideration. Jerry Jasinowski of the National Association of Manufacturers expressed this concern in recent Congressional testimony, noting that tax reform in conjunction with other negative short-term impacts could conceivably tip the scale, engendering a cyclical downturn during the first six months of 1987.

EVANS
An across-the-board reduction in land prices will more than offset the impact of higher construction costs on rents.
UPI/Bettmann Newsphotos

Bucking the trend, at least two prominent economists, John Makin and Michael Evans, do not concur with the prevailing consensus. Both economists believe that the loss or curtailment of investment incentives has been substantially discounted in the capital markets. With the cancellation of the investment tax credit now behind us, Evans Economics, Inc. projects 2 percent or better growth in 1987. Dr. Makin, on the other hand, believes that a recession is clearly possible. However, he considers large budget and trade deficits, not tax policy, to be the principal threats to a sustained recovery.

Eating Our Seed Corn?

Aggregate investment in the United States is well below the level considered optimal for long-run economic growth. In an effort to remedy this problem, a number of investment and saving incentives have been introduced into the tax code in recent years.

Tax reform represents a sharp departure from this policy. A number of proinvestment and prosaving tax incentives—the Investment Tax Credit, accelerated depreciation, and the Individual Retirement Account being the most notable—have been either eliminated or curtailed. The question arises as to whether tax reform constitutes an injurious policy toward investment.

If asked this question, most business economists as well as a few notable academic economists would answer with a resounding yes. By lowering the after-tax cost of capi-

tal, corporate America has been afforded the incentives and wherewithal to retool an aging capital stock. The loss of such incentives is perceived as detrimental to American industry: diminishing the ability of American manufacturers to compete both at home and abroad, reducing productivity growth, and hastening the demise of a number of beleaguered manufacturing industries.

This sentiment was echoed by DRI economist Roger Brinner in the following statement to Congress shortly before the historic legislation was signed into law: "The imposition of tax reform—which not only raises business taxes but also exchanges high powered incentives like the investment tax credit and accelerated depreciation for low powered statutory rates—will slow the retooling of factories and keep construction depressed . . . ." Estimates by DRI indicate that the lower investment level under tax reform more than offsets any potential gains in efficiency, higher labor participation rates, or lower interest rates.

Projections by both Chase and Wharton Econometrics substantiate DRI's assessment. In a ten year forecast of investment in 50 some industries, the University of Maryland consulting firm INFORUM finds that investment will be no greater—and in many industries less—than it would have been without tax reform.

In strongly worded Congressional testimony, Harvard economist Lawrence Summers warned that the loss in economic output from reduced investment will far exceed the rather speculative gains to be realized from improved efficiency. He went on to say that tax reform will reduce long-run economic output by at least 3 percent, adding that this estimate understates the loss since it fails to account for a slow down in technical progress. He concluded his testimony by noting the new tax bill fails to address one of our nation's most urgent economic problems: insufficient national savings.

FELDSTEIN

Low- and moderate-income renters will lose as higher construction costs force rents up.

UPI/Bettmann Newsphotos

The capital formation incentive argument is not without its critics. Many economists question the effectiveness of such incentives, noting that in many industries tax considerations have little or no effect on the level of business investment. Moreover, it is not altogether clear how investment incentives interact with other determinants of investment such as interest rates, exchange rates, and prices. Finally, some economists object to the very premise underlying incentives; namely, taxpayers should be required to subsidize private investment or savings.

The most notable critic of investment incentives is Robert Eisner of Northwestern University. Having specialized in the area of investment research, Dr. Eisner has found that investment incentives generally yield a very low rate of return. While acknowledging that the "bang for the buck" is rather high for certain industries, on average investment increases by only 40 cents for every tax dollar spent on incentives. Moreover, since the level of economic activity has been found to be a much more important determinant, such incentives tend to be much less effective during an economic slump. Dr. Eisner does believe that the government has a role in promoting capital formation; however, he believes that tax dollars would be better spent on social overhead capital such as transportation, education, and research & development.

John Makin of the American Enterprise Institute also favors the move toward fewer investment incentives. In Congressional testimony he noted that the new tax bill would raise the after-tax cost of capital by 5 to 10 percent assuming that interest rates remain unchanged. However, by slowing household debt accumulation, a favorable impact on interest rates could be expected. Taking this factor into consideration, he foresees little, if any, change in the user cost of capital.

Michael Evans takes Dr. Makin's analysis one step further by arguing that cost of capital to man-

ufacturing industries will actually fall under tax reform. By eliminating or curtailing a multitude of tax shelters, the new tax bill will induce a substantial shift in financial resources from the nonresidential construction sector to the stock market. In addition to raising share prices, this shift will benefit the long beleaguered manufacturing sector through a reduction in the cost of equity capital.

A Level Playing Field

Tax reform reversed a 20-year decline in corporate tax revenues and reduced the traditional preference for smokestack industries. This was no accident: from the outset, the framers of the principal tax reform proposals made a conscious effort to equalize the effective tax rate on different industries. This intent is succinctly captured in a comment by Beryl Sprinkel, chairman of the Council of Economic Advisers. "Our objective," he said, "is to create a level playing field so that capital would flow into the most efficient portions of the economy and, therefore, get the maximum bang for the buck, and although Congress and the administration did not succeed completely, they made major progress toward that goal."

Proponents of a "level playing field" argue that disparities in effective tax rates funnel scarce resources into otherwise unprofitable activities or investments and, in so doing, siphon funds from other investments yielding a higher pre-tax rate of return. Commenting on this issue Alan Greenspan states: "If all investments were made on the basis of pre-tax earnings, with depreciation reflecting true economic wear and tear, then capital would be directed toward those investments which have the highest marginal productivity."

Although empirical evidence is not yet available, two preliminary studies completed before the new tax bill was enacted into law suggest that the administration accomplished at least part of its objective. In a paper which examines the extent to which current tax law favors high-income owner occupied housing and penalizes investment in inventories, Patrick Hendershott finds that the administration's original tax proposal would lead to a more efficient allocation of capital—one that is less biased toward high-income housing. In a related study, Don Fullerton and Yolanda Henderson find that both the Treasury plan and the president's proposal would generate net welfare gains even with slight declines in the capital stock. Given the broad similarities between the various tax reform proposals and the final bill, there is reason to expect the new tax code to yield similar results.

At least several notable economists believe that the administration and Congress did not go far enough. While touting the many virtues of the new bill, Alan Blinder noted that the failure to tax most fringe benefits and close the various loop holes for the oil and gas industry leave some important tax preferences untouched. John Makin went even further, suggesting that the full deductibility of state and local taxes and preferential treatment of owner occupied housing be eliminated. By relinquishing $70 to $80 billion in potential revenue, he believes that Congress is preordaining an "increase in corporate taxes to finance politically attractive and economically useful tax rate reductions for households and businesses." Despite these criticisms both economists are in agreement that the move toward a broader tax base is a step in the right direction.

FRIEDMAN

Revising the 16th Amendment to the Constitution is the only way to improve the tax structure permanently.

UPI/Bettmann Newsphotos

Opponents of a neutral tax system, on the other hand, maintain that the remedy is worse than the cure. While acknowledging that an unequal tax burden results in a misallocation of resources, they believe that purported gains in economic efficiency are far outweighed by the concomitant reduction in aggregate investment. Lawrence Summers

underscores this position when he says, "The adverse impact of reduced investment incentives will far exceed the rather speculative neutrality benefits stressed by proponents of tax reform." At least one study would seem to support this contention: even after making generous allowances for efficiency gains, DRI finds that a decline in the capital stock will more than offset any gain in efficiency.

Even Alan Blinder, a major supporter of the new legislation, questions the wisdom of raising taxes on new investment and cutting taxes on old investment. While this represents an essential first step toward equalizing effective tax rates, it has the perverse effect of turning the incentive mechanism upside down: rewarding the owners of existing capital and penalizing new investors.

Jerry Jasinowski, the most vociferous critic of a neutral tax system, questions much of the theoretical and empirical work underlying the recent shift toward a "level playing field." He argues that ". . . authors articulating this position appear to be defining efficiency tautologically." He goes on to say that "Using a definition of this type, it is obvious . . . that the removal of targeted incentives would raise efficiency. However, this reasoning does not lend itself to empirically valid propositions." Finally, he believes that a "level playing field" is a misnomer since American producers are not afforded the same preferential tax treatment as are foreign producers.

Assessing the Imponderables

Many of the issues addressed may hinge on a number of imponderables. One such consideration is government revenue. Although every effort was made to project revenues in an objective and realistic fashion, there is a significant chance that the new tax system may take in considerably more or considerably less revenue than expected. A revenue shortfall could result in a ballooning deficit, pushing interest rates higher, exacerbating the loss in investment incentives, and precipitating a recession. A revenue gain could, of course, have the opposite effect.

While a revenue shortfall or gain could have a profound effect on the economy, most of the economists reviewed do not explicitly account for such a possibility, considering such estimates to be inherently speculative. In a rather candid remark on the subject, Alan Blinder says, "In truth, no one knows whether the bill will ultimately gain or lose revenue." Alan Greenspan echoes the same sentiment when he says, ". . . in effect, we are making changes in tax rates and other provisions with a cumulative impact, positive and negative, of nearly $1 trillion over the next five years. I would consider any analyst who came within $10 billion a year of the correct revenue differential to be either very lucky, deserving of an award, or both."

John Rudlege offers an alternative view. He argues that lower tax rates and the elimination of tax shelters will in all likelihood engender a major portfolio restructuring away from tangible assets such as oil, gas, real estate, and other sheltered assets toward financial assets, like stocks, bonds, and bank accounts. If Dr. Rudlege is correct, tax reform would have a major deflationary impact on the economy, reversing the run up in the prices of tangible assets witnessed during the inflationary 1970s. Unfortunately, there are few if any ways of establishing the empirical validity of this theory until, of course, it actually happens.

Finally, it should be noted that most if not all of the major economic variables influenced by the new tax bill—exchange rates, interest rates, labor supply, aggregate investment, etc.—are inextricably

SPRINKEL
The tax bill made major progress toward creating a level playing field so capital will flow into the most efficient portions of the economy.

UPI/Bettmann Newsphotos

intertwined. When considered in isolation, an assessment of the qualitative relationship between these variables and the new tax bill is relatively straightforward. When considered in conjunction, however, the analysis becomes much more complicated. Commenting on this issue Alan Greenspan states: "Macromodels can evaluate effectively only changes made at the margin, that is, small tax changes and/or small expenditure changes. Policy innovations which create abrupt changes in the incentive structure, which the bill surely would do, present far more difficult analytical problems."

The Tax Bill to End All Tax Bills

Despite comments to the contrary by President Reagan and other major framers of the new tax bill, most political analysts agree that Congress will soon return to one of its more favorite pastimes: revising and modifying the tax code. This will occur if for no other reason than to make technical corrections in the new tax bill. While fundamental changes are much less likely, even this possibility should not be ruled out.

At least several economists foresaw the necessity of such changes even before the new bill was signed into law. In his concluding remarks before the September meeting of the Joint Economic Committee, Alan Greenspan stated: "There almost surely will be a significant number of unintended impacts from this bill. Perhaps 10 to 20 important mistakes will appear in retrospect. We will not know what they are, however, until after the bill is enacted and the problems surface. Hence, a much easier forecast than what the tax bill will do to the economy is what it will do to Congressional debate. As a consequence of the Tax Reform Act of 1986, there will be more tax reform bills and, perhaps in 1988 as well."

At the same meeting Lawrence Summers underscored one of the dangers associated with the new tax bill. Noting that the tax bill may precipitate or prolong a recession he said, "Serious consideration should be given to reinstituting the investment tax credit in the near future especially if investment spending does not rebound with the resolution of tax reform uncertainties." Dr. Summers also believes that the failure to index the new tax bill fully to inflation represents a serious omission. Both supporters and opponents of the new tax bill are in agreement on this issue.

UPI/Bettmann News/Photos

On the other hand, proponents of the new tax code agree that Congress should not jeopardize the spirit of the new tax bill by introducing provisions which will inevitably erode the tax base and increase marginal tax rates.

Milton Friedman takes this position to its logical extreme, arguing that the Constitution should be amended to prevent the incessant proliferation of tax preferences. Since Congress has and in all likelihood will continue to use tax legislation as a method for raising campaign contributions, Dr. Friedman believes that the current move toward a broad-based tax is at best temporary. As a way of circumventing what he believes to be an obvious failure in the political process, Dr. Friedman says, "The only way that I can see to get a permanent improvement in the tax structure is to revise the 16th Amendment to the Constitution—which now reads 'The Congress shall have the power to lay and collect taxes on incomes, from whatever sources derived'—by adding 'Provided that the same tax rate is applied to all income in excess of occupational and business expenses and a personal allowance of a fixed amount.'" While few economists would go so far as to recommend such draconian measures, most would agree that sound economic reasoning often gets lost in the shuffle of political wheeling and dealing.

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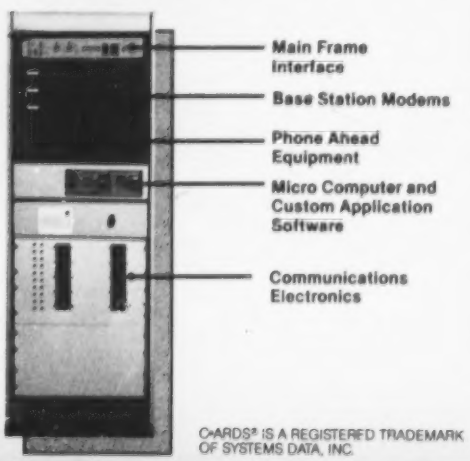

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FINANCIAL REVIEW

EARNINGS UP; QUALITY OF EARNINGS IMPROVES AS AFUDC DECLINES

The investor-owned electric utility industry's third quarter earnings (before extraordinary items) totaled $0.96 per share, a 4.3 percent increase over last year's third quarter. This quarterly increase in earnings per share—the first after five quarters of flat-to-negative earnings—brought third quarter twelve-month-ended 1986 earnings to $3.00 per share. The $3.00 figure is 2.6 percent lower than the $3.08 the industry earned during the twelve-month period ending September 30, 1985.

The reversal of the recent quarterly downtrend and the improvement over last year's annual per share earnings can be attributed to increases in electric operating revenues, decreases in fuel expense, increases in non-electric income, reductions in investment tax credits, and rate relief. These were offset by significant reductions in allowance for funds used during construction (AFUDC), increases in depreciation and income tax expense, and an increase in the number of common shares outstanding.

Earnings quality increased as AFUDC in net income declined. The $1.6 billion of AFUDC recorded at the end of the third quarter of 1986 was a 17.5 percent reduction from the third quarter of 1985. Consequently, AFUDC as a percentage of net income available for common dropped to 27.9 percent on September 30, 1986, from 36.5 percent last year. For the twelve months ending September 30, 1986, AFUDC accounted for 43.3 percent of net income available for common, down from 47 percent one year earlier. The decrease in AFUDC continues to be largely a result of the completion of several large construction projects within the past year. Additionally, AFUDC decreases have been caused by companies no longer accruing AFUDC on troubled or cancelled plants.

The return on average common equity (ROE) (before extraordinary items) was 13.6 percent for the twelve-month period, compared to 14.2 percent for the twelve months ending September 30, 1985. The change in ROE was influenced by the increase in average common equity and reflects the downtrend in the allowed returns granted by commissions.

The pre-tax interest coverage ratios reflected the rebound that took place in the third quarter as both the quarterly and the twelve-month-ended pre-tax interest coverage ratios improved over the previous year's results. The table below illustrates how rising pre-tax income outpaced interest expenses to push up pre-tax interest coverage ratios, both with and without AFUDC.

Pre-Tax Interest Coverage Ratios:

	Third Quarter		Year Ended September 30,	
	1986	1985	1986	1985
With AFUDC	3.82	3.57	3.12	3.08
Without AFUDC	3.41	3.07	2.68	2.55

The downward trend in industry fuel costs continued in the third quarter of 1986 as fuel expense dipped 12.3 percent to $8.9 billion from $10.1 billion in 1985. This downtrend is caused by an increased utilization of nuclear generating capacity and declining fossil fuel costs. Additionally,, Department of Energy statistics indicate that the reduction in fossil fuel prices has made oil a competitive alternative to gas in some areas of the country. Oil-fired generation for the total electric utility industry reached 42.4 million megawatt-hours in the third quarter of 1986 (a 65.9 percent increase over last year's third quarter). Most of this increase came at the expense of gas-fired generation.

Total utility plant increased 9.5 percent to $267.4 billion from September 30, 1985, to September 30, 1986. Construction work in progress (CWIP) dropped again as the $90.2 billion on record as of September 30, 1985, decreased 6.5 percent to $84.3 billion this past September. The drop in CWIP can be attributed to a reduction in construction expenditures, the completion of new plants, and the disallowance/discontinuation of plants during the past twelve months.

The industry continued to take advantage of relatively low interest rates by refunding $9.3 billion in long-term debt in the first three quarters of 1986, according to Ebasco Business Consulting Company. This is almost a tenfold increase over the $963 million refunded last year. The lower nominal interest rates allowed electric utilities to reduce their embedded cost of long-term debt to 10.1 percent during the twelve-month period ending September 30, 1986, down slightly from the 10.3 percent recorded a year ago.

Tables 1 and 2 are based on unaudited reports submitted by a sample of investor-owned electric utilities. The sample is representative of approximately 94 percent of the industry's sales to ultimate customers and 93 percent of the industry's total assets. This sample is then used to extrapolate the entire investor-owned electric utility industry.

Contributed by the Finance Department of Edison Electric Institute.

Table 1
Investor-Owned Electric Utility Industry Statement of Income
(Unaudited)
(Millions of Dollars)

	Three Months Ending September 30,			Twelve Months Ending September 30,		
	1986	1985	% Change	1986	1985	% Change
Total Electric Operating Revenues[1]	$36,217	$34,891	3.8	$127,267	$123,758	2.8
Electric Operating Expenses						
Fuel	$ 8,877	$10,128	(12.3)	$ 33,721	$ 37,178	(9.3)
Other Operation & Maintenance	8,928	8,330	7.2	33,820	32,111	5.3
Depreciation & Amortization	2,960	2,625	12.8	11,251	10,012	12.4
Taxes Other Than Income Taxes	2,548	2,354	8.2	9,346	8,787	6.4
Income Taxes: Federal & Other	2,879	2,391	20.4	6,296	5,235	20.3
Deferred Income Taxes	1,441	1,138	26.7	4,942	4,848	2.0
Investment Tax Credits, Net	360	537	(32.9)	1,758	1,703	3.3
Total Electric Operating Expenses	$27,993	$27,501	1.8	$101,133	$ 99,872	1.3
Electric Operating Income	$ 8,224	$ 7,389	11.3	$ 26,134	$ 23,885	9.4
Other Utility Operating Income	108	105	2.9	1,470	1,429	2.9
Total Utility Operating Income	$ 8,332	$ 7,494	11.2	$ 27,605	$ 25,314	9.0
Other Income & Deductions, Net	579	633	(8.5)	2,344	2,491	(5.9)
Allowance for Other Funds Used During Construction	1,035	1,256	(17.6)	4,461	5,196	(14.1)
Total Income Before Interest Charges	$ 9,946	$ 9,383	6.0	$ 34,409	$ 33,001	4.3
Interest Charges						
Interest on Long-Term Debt	$ 3,772	$ 3,710	1.7	$ 15,071	$ 14,502	3.9
Other Interest Expenses & Charges	215	255	(15.8)	935	1,035	(9.7)
Allowance for Borrowed Funds Used During Construction	(588)	(712)	(17.4)	(2,480)	(3,052)	(18.7)
Net Interest Expenses & Charges	$ 3,399	$ 3,253	4.5	$ 13,526	$ 12,485	8.3
Net Income Before Extraordinary Items	$ 6,547	$ 6,130	6.8	$ 20,883	$ 20,516	1.8
Extraordinary Items	(75)	0	N.M.	(2,072)	(55)	N.M.
Net Income	$ 6,472	$ 6,130	5.6	$ 18,811	$ 20,461	(8.1)
Preferred Dividends Declared	661	733	(9.8)	2,792	2,899	(3.7)
Net Income Available for Common	$ 5,811	$ 5,397	7.7	$ 16,019	$ 17,562	(8.8)
Common Dividends Declared	2,968	3,011	(1.4)	11,851	11,850	0.0
Additions to Retained Earnings	$ 2,843	$ 2,386	19.2	$ 4,168	$ 5,712	(27.0)
Average Shares Outstanding	6,142	5,881	4.4	6,038	5,712	5.7
Earnings Per Share Before Extraordinary Items[2]	$ 0.96	$ 0.92	4.3	$ 3.00	$ 3.08	(2.6)
Earnings Per Share After Extraordinary Items[2]	$ 0.95	$ 0.92	3.3	$ 2.65	$ 3.07	(13.7)
Common Dividends Per Share[2]	$ 0.48	$ 0.51	(5.9)	$ 1.96	$ 2.07	(5.3)

NOTES:
[1]Revenues are adjusted for intra-industry sales for resale of electricity.
[2]Based on average shares outstanding as reported to EEI by survey respondents and adjusted for stock splits.
N.M.—Not Meaningful.

Table 2
Investor-Owned Electric Utility Industry Balance Sheet
(Unaudited)
(Millions of Dollars)

Assets	September 30, 1986	September 30, 1985	% Change
Utility Plant*			
Utility Plant (Including Nuclear Fuel)	$369,221	$335,982	9.9
Less Accumulated Depreciation	101,834	91,712	11.0
Total	$267,387	$244,270	9.5
Construction Work in Progress	84,254	90,157	(6.5)
Net Utility Plant	$351,641	$334,428	5.1
Investments	8,328	7,669	8.6
Current Assets	39,477	38,129	3.5
Deferred Debits	19,947	19,267	3.5
Total Assets	$419,393	$399,492	5.0
Capitalization & Liabilities			
Capitalization			
Common Stock	$ 86,293	$ 84,136	2.6
Retained Earnings	49,487	45,523	8.7
Preferred Stock	29,911	31,556	(5.2)
Long-Term Debt	152,633	147,087	3.8
Total Capitalization	$318,324	$308,302	3.3
Current Liabilities			
Short-Term Debt	$ 5,205	$ 4,654	11.8
Long-Term Debt Due Currently	5,862	4,668	25.6
Other Current Liabilities	28,560	28,158	1.4
Total Current Liabilities	$ 39,627	$ 37,480	5.7
Deferred Credits			
Accumulated Deferred Income Taxes	$ 36,831	$ 30,792	19.6
Accumulated Deferred Investment Tax Credits	16,371	15,276	7.2
Other Deferred Credits	8,240	7,642	7.8
Total Deferred Credits	$ 61,442	$ 53,710	14.4
Total Capitalization & Liabilities	$419,393	$399,492	5.0

*Includes non-electric utility plant.

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TECHNOLOGY REVIEW

ELECTROMAGNETIC PULSES AND THE ELECTRIC POWER NETWORK

Enrico Fermi suggested there would be electromagnetic effects from the first nuclear explosion in 1945, and indeed some instrumentation failures in that first test were attributed to electromagnetic pulses (EMP). Yet much is still unknown about the possible effects of the EMP that would be released in a thermo-nuclear war.

Some experts believe that the detonation of a nuclear weapon in space about 300 miles over the central United States—an altitude too high to cause heat and shock waves below—could cause coast-to-coast disruptions in the nation's electric power network. Gamma rays from the nuclear explosion would interact with air molecules to produce high-energy free electrons (known as Compton electrons), which, when accelerated by the earth's magnetic field, would produce an intense electromagnetic field on the earth's surface. Power lines, phone lines, unshielded control cables, and communication systems would attract the energy from the EMP. The resultant surges would cause extensive damage to power apparatus and equipment, particularly solid-state system control equipment.

While the transient surges caused by EMP are similar to those caused by lightning, there are important differences. The EMP surges can produce much higher voltages than those produced by lightning. Furthermore, lightning normally strikes a single entry point, while the EMP would enter transmission and distribution systems at many points simultaneously. In effect, a T&D system would act as an antenna to receive and transmit EMP. Similar effects, although on a much smaller scale, have been caused by solar-induced currents from geomagnetic storms (sunspots).

"We don't know how to protect against this fast a rate of [voltage] rise," says Kenneth Klein of the electric energy systems division of the U.S. Department of Energy (DOE), director of a major research program aimed at reducing vulnerability to EMP. "We don't know if even the best lightning resistors would provide protection."

In addition to overvoltage stresses on the power system surge protection equipment, EMP have the potential to produce overcurrent conditions and could cause relaying problems, transformer heating, or unusual VAR flows. Electronic control equipment used for power system monitoring and control functions—which may or may not be shielded—is thought to be especially vulnerable to EMP-induced surges.

Even if the transmission system can withstand EMP surges, systemwide EMP-induced transients may cause serious power system operating problems. For example, widespread overcurrent problems in distribution circuits could cause load-shedding, leading to large generation and load mismatches. In addition, there may be significant power system stability problems. Furthermore, the damage to generation, transmission, distribution, and control equipment could make system restoration especially difficult.

Vulnerability assessment is the first phase of the DOE research program, which was launched in 1983. "Some speculate that EMP could cause a total blackout of the U.S.," Klein explains, "while others say 'no.' We still don't know the answers." Based on the results of this impact assessment, DOE will develop operation and control procedures and protection hardware. DOE expects to complete the research and issue recommendations in about five more years.

"We probably can't afford a total hardening [protection] of the system," Klein says. "It's likely that we will harden only the critical choke points. And there's a lot of effort being put into making sure we can restore power after an event."

Klein noted that retrofit of protection hardware would probably be prohibitively expensive. A more viable option is gradual replacement by using new protection hardware in new installations.

The DOE research program is primarily motivated by national security concerns. Its main focus is to develop technologies and systems to provide power to essential loads such as military installations, civil defense facilities, and critical industries; to reduce damage to the overall system; and to minimize the time the public would suffer a power outage.

But Klein notes that the research program may help design engineers make cost-effective improvements in the quality of T&D systems and equipment, yielding a more reliable power system during normal operations as well.

Contributed by Karen Haas Smith, a Washington-based freelance writer specializing in energy topics.

REGULATORY REVIEW

SUPERFUND'S COMMUNITY RIGHT-TO-KNOW AND EMERGENCY PLANNING PROVISIONS

The Superfund Amendments and Reauthorization Act of 1986 (SARA), which was signed into law on October 17, 1986, will have substantial impact on many business activities including those of electric utilities.

The most publicized aspects of SARA during the reauthorization process were those provisions regarding the clean-up of hazardous waste sites. Congress provided the Environmental Protection Agency (EPA) $8.5 million for clean-up over the next five years and directed EPA to initiate clean-ups within stringent time frames. EPA's authority to compel private parties to pay for clean-ups was also reinforced. Citizens and the states were granted considerable opportunity to participate in the clean-up process.

A less well-known aspect of SARA is Title III, which establishes the "Emergency Planning and Community Right-To-Know Act of 1986." According to EPA, this Act is "intended to encourage and support emergency planning efforts at the state and local level and provide residents and local governments with information concerning potential chemical hazards present in their communities" [51 *Federal Register* 41570 (November 17, 1986)]. The provisions of Title III are an outgrowth of the events at Bhopal, India, in December 1984.

These provisions impose substantial new disclosure requirements on businesses that use certain toxic substances. All utility facilities that have "present" such substances in excess of identified "threshold planning quantities" must be identified to state and local emergency planning groups by May 17, 1987. Such facilities must participate in emergency planning activities to be coordinated

Les Moore/Unphoto

at the state and local level. Utilities must also immediately report certain emergency releases of such substances. According to EPA, the emergency notification requirements are already effective. State emergency response commissions must be appointed by April 17, 1987. Local emergency planning districts must be established by July 17, 1987, and notification of facility representatives must be made by September 17, 1987.

Utility participation in the reporting and emergency planning process is triggered by the "presence" at any "facility" of any of a list of over 400 "extremely hazardous substances." On November 17, 1986, EPA issued an interim rule that identified such substances and established for each substance a threshold planning quantity (the presence of which triggers identification by May 17, 1987, of facilities subject to emergency planning) and a reportable quantity (which immediately triggers emergency reporting if exceeded). The EPA list included several substances that could be present at utility facilities, such as chlorine, pentachlorophenol, sulphuric acid, and hydrazine. In some cases, EPA imposed a very high reporting threshold (e.g., 10,000 pounds for releases of pentachlorophenol). In a related rulemaking, EPA proposed to delete some substances, such as pentachlorophenol, from the list. In addition, the Act exempts federally permitted releases from at least the emergency reporting requirements.

Edison Electric Institute's Superfund Subcommittee addressed the EPA rules in comments filed on January 2, 1987. These comments sought to assure that the reporting requirements focused upon those substances and quantities that truly could cause a Bhopal type of emergency. Thus EEI, for example, supported EPA's proposal to delete pentachlorophenol from the list.

Notwithstanding these activities, many utility facilities may be subject to the emergency planning requirements. Utilities will have to inventory the presence and amount of these "extremely hazardous substances" in time to file reports by May 17, 1987.

Although there is reason to believe that the emergency release notification requirements also should not go into effect until May 17, EPA has stated that those requirements were effective as of November 17, 1986. Utilities must have procedures to make such notifications. To comply with the emergency release reporting requirements, utilities must determine whether the "facility" "produces, uses, or stores" one of the over 400 "extremely hazardous substances" or one of the 717 "hazardous substances" designated by EPA, whether the amount released exceeds the reportable quantity established by EPA, and whether the

release is exempted from reporting (i.e., is it federally permitted?). If these requirements are met (and the release is not exempted), the utility must provide notification immediately to the relevant local or state emergency response personnel. If such personnel cannot be identified or are not known, EPA suggests that emergency notification be made by telephoning "911" or "Operator." Such notice should include information about health risks and medical advice, if known, but EPA advises that notice should not be delayed if such information is not known. Because of the complexity of these requirements and the importance of notification, each company should have a strategy that advises employees when and how to report.

Violations of these requirements can result in civil penalties of up to $25,000 for each day of violation. Criminal penalties may be imposed on "any person [that] knowingly and willfully fails to provide notice. . . ."

Some utilities have already conducted chemical inventories to comply with state or local community right-to-know laws. Many utilities have extensive emergency planning capabilities. The EEI Superfund Subcommittee discussed these requirements at the February 1987 meeting of the Environmental and Energy Committee to assist utilities in complying with the new requirements. The Superfund Subcommittee will continue to assist utilities that wish to participate actively in the emergency planning process at the state and local level.

Some utility activities may also be subject to reporting under Section 311 of SARA. If a utility has prepared or is keeping a Material Safety Data Sheet (MSDS) for a chemical under the Occupational Health and Safety Administration's Hazard Communication Standard, the company is likely to have to submit MSDSs under Section 311 to the local emergency planning committee, state emergency response commission, and local fire department. It may also have to submit Section 312 "inventory forms" for such chemicals. Section 313 of SARA contains a completely different reporting scheme that does not currently apply to utilities but could be expanded to cover them in the future. It requires submission of "toxic chemical release forms" providing a wide range of information.

Contributed by the Office of the General Counsel, Edison Electric Institute.

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BOOK REVIEW

THE MEDIA ELITE

S. Robert Lichter, Stanley Rothman, Linda S. Lichter
Adler & Adler, 1986
Bethesda, Maryland, 342 pp.

Reviewed by Robert A. Lincoln

It is wrong to assume that "conspiratorial bias" controls media coverage. That is the message in *The Media Elite* after a detailed sociological study. The book puts it this way:

"The whole notion of bias has become a straw man that obscures the far less obvious (and less nefarious) processes that mediate between journalists' perspectives and their product."

In other words, deal with news coverage not on the basis of bias but of the whole collection of human factors that influence it. Although the book does not number these factors in laundry-list form, it points up the meaningful ones. As a prime example, journalism clearly attracts people of liberal inclination and they "tend to perceive elements of social controversies in terms that correspond to their own attitudes."

Bias, no. Belief, yes.

To those who complain about modern media coverage, the difference between bias and belief may not be that significant. The resultant slant of the coverage is what counts. However, *Media Elite*'s long study leads to the conviction that the first task is to analyze the factors influencing the individual journalist.

This is not to suggest that *Elite* glosses over coverage errors or the certainty that the political influence of journalists is on a strong and, to many people, frightening upswing. Far from it. But identifying the causes of a problem before deciding whether and how to deal with it is the pointed contribution of *Elite*'s three authors. That is the prime reason utility executives, not just their staffers, should scrutinize the book. Not that it reads like a novel, obviously enough. It has the handicap of

being a serious sociological study which lacks a neat beginning, middle, and end.

But chapter 6 alone is worth the price of the book. The chapter examines in depth the way seven major national media—*The New York Times*, the three chief weekly newsmagazines (*Time, Newsweek*, and *U.S. News & World Report*), and the three commercial tv networks in their evening newscasts (ABC, CBS, and NBC)—covered a story from 1970 through 1983.

The story in question: nuclear power. After their own poll of leading scientists and engineers, the authors declare "the results showed that most energy specialists support nuclear development . . . (while) in sharp contrast, major media coverage highlighted the uncertainties attending nuclear power."

In support of this observation, *Elite* takes the attitudes of a representational sample of technical experts on a long list of issues, from nuclear development to waste disposal to whether the matter is mainly moral or political. It tabulates the results against the opinions of science journalists. The figures tell the story. Typically, the journalists are much less hopeful and favorable than scientists and engineers are.

Elite follows this up with further checks. Charts show the heavy emphasis media gave to nuclear safety questions, the fact that media judgments were more often negative than positive, and so on. The chapter runs to more than fifty pages; in this case, length indicates the extent of the analysis.

It goes without saying that nuclear power is not the only subject whose coverage *Elite* examines. It is curious about education and busing, for example, and charges of monopoly in oil. It treats a variety of topics concerning the journalistic character—what kinds of people enter the field, why they do so, and how their interests and leanings affect their reports. Most readers will want to skip the chapter on the media mind, where the study explores journalists' psyches with a Rorshach kind of technique.

"And That's the Way It Is . . .," title of the last chapter, may be the subconscious theme of the entire book. For journalism, in keeping with the responsibility the Founding Fathers gave to the Fourth Estate, has a prominent place in society. Journalists are human beings and therefore subject to human frailties. Both members and critics of journalism must keep these plain facts in mind.

The Media Elite has both general and specific value to the utility industry. In examining an issue of overall public interest, the book has taken as a point in question a specific matter, nuclear energy, that directly involves electric power. This kind of recognition underscores the public position of the industry, and it makes the book that much more important to industry personnel.

Robert A. Lincoln was a career officer in the United States foreign service and has done considerable research and writing for the investor-owned electric utility industry.

Sue Klemens/Unicfoto

STATISTICAL REVIEW

CHANGING CONSUMPTION PATTERNS IN FUEL USE

The use of coal to produce electricity has gradually increased over the last few years with a significant annual growth rate from 1982 through 1985. Consumption of coal increased in all regions of the contiguous United States in 1985, compared to a year earlier, with large increases recorded in the West South Central and East South Central regions, 14.9 percent and 11.5 percent, respectively. Coal accounted for more than 55 percent of the total electricity generated in 1985 by all sources of energy. A total of 11 coal-fired units with a total net expected summer capability of 5,175 megawatts were added to electric power systems during 1985. Net generation from coal-fired plants in 1985 was 1,384,464 megawatt-hours. Approximately one-third of this coal-fired generation was produced in Ohio, Pennsylvania, Texas, West Virginia, and Indiana.

Nuclear power provided 15.5 percent of total electric generation in 1985, surpassing hydroelectric power for the second consecutive year as the second highest energy source. Eight nuclear units were placed in commercial operation during 1985 and represented a total net expected summer capability of 9,001 megawatts. This brings the total to 91 nuclear units in commercial operation as of January 1, 1986. Generation of electricity by nuclear power has increased over 40 percent during the last five years (269,803 gigawatt-hours in 1981 to 379,165 gigawatt-hours in 1985). For the first six months of 1986, generation by nuclear power has increased about 5 percent over the same period a year earlier.

The consumption of oil for the production of electricity has steadily declined since 1979, and during 1985 accounted for only 4.1 percent of the total generation by all energy sources. However, the use of oil to generate electricity in the first six months of 1986 showed an increase of 23 percent as compared to the same period in 1985. This is mainly due to the drastic decrease in the price of a barrel of oil in the early months of 1986 and purchases on a spot market basis.

Fewer cubic feet of natural gas were consumed to produce electricity in 1985 than in 1984. However, in 1985, four geographic regions in the contiguous United States showed significant increases in the consumption of natural gas: Mountain, 71.1 percent; New England, 30.5 percent; Pacific, 15.1 percent; and East North Central, 14.1 percent. All other regions reported decreases in consumption, with the largest decrease occurring in the West North Central (33.8 percent).

The average cost of coal consumed in the production of electricity steadily increased from 1976 to 1983; since then, the price has remained fairly constant at an average of approximately $36 per ton. In contrast, the average cost per barrel of oil increased dramatically between 1978 and 1981, reaching a high of $33; in 1985, the average cost per barrel had declined to $28 and further declined to an average of $14 per barrel in May 1986. The average cost per thousand cubic feet (MCF) of natural gas also has been declining to remain competitive with oil.

Full data on fuel use appears in *Statistics on Fuel Used to Generate Electricity by the Electric Utility Industry 1985*, just published by the Statistics Department of Edison Electric Institute.

Contributed by the Statistics Department, Edison Electric Institute.

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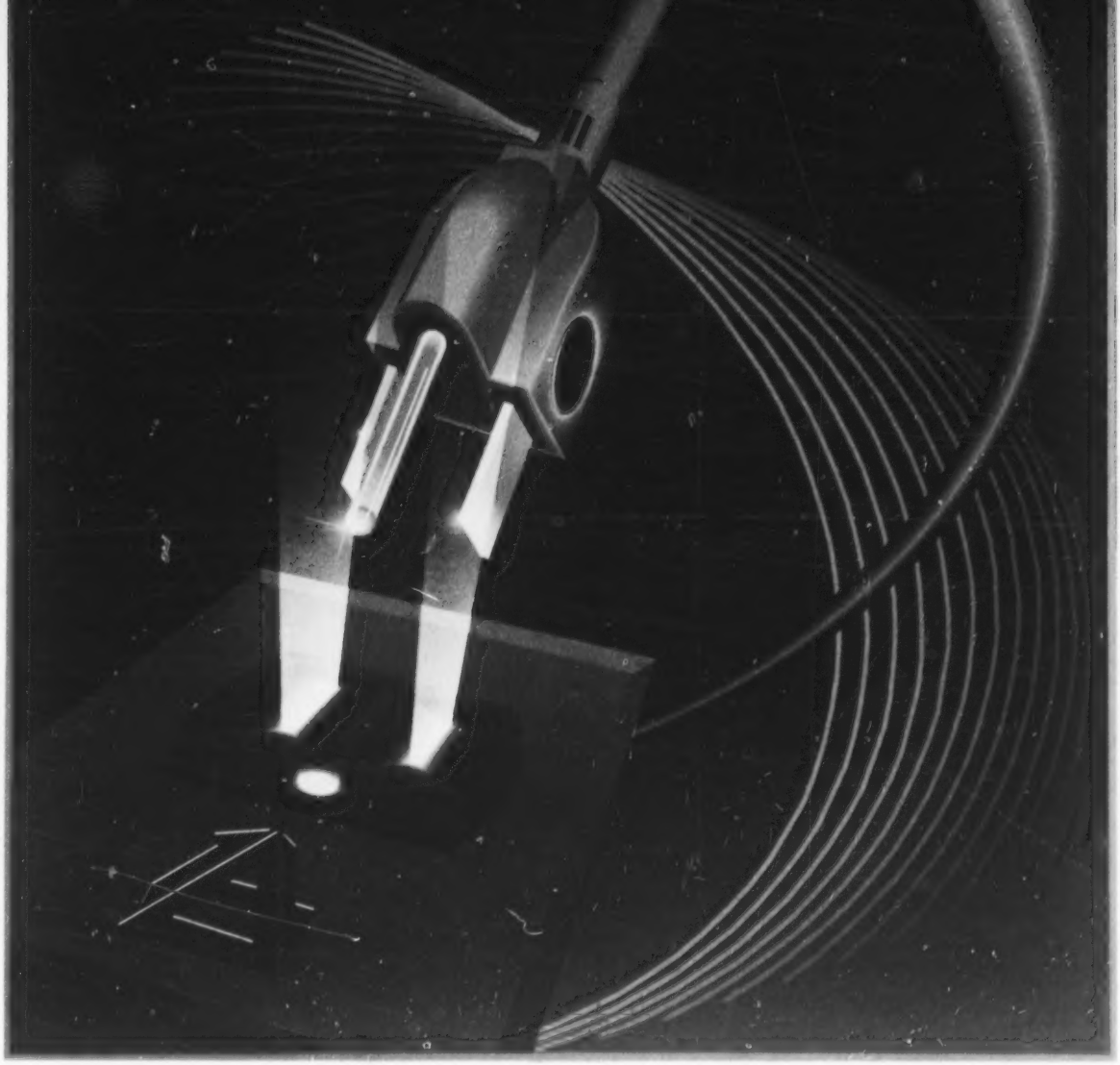

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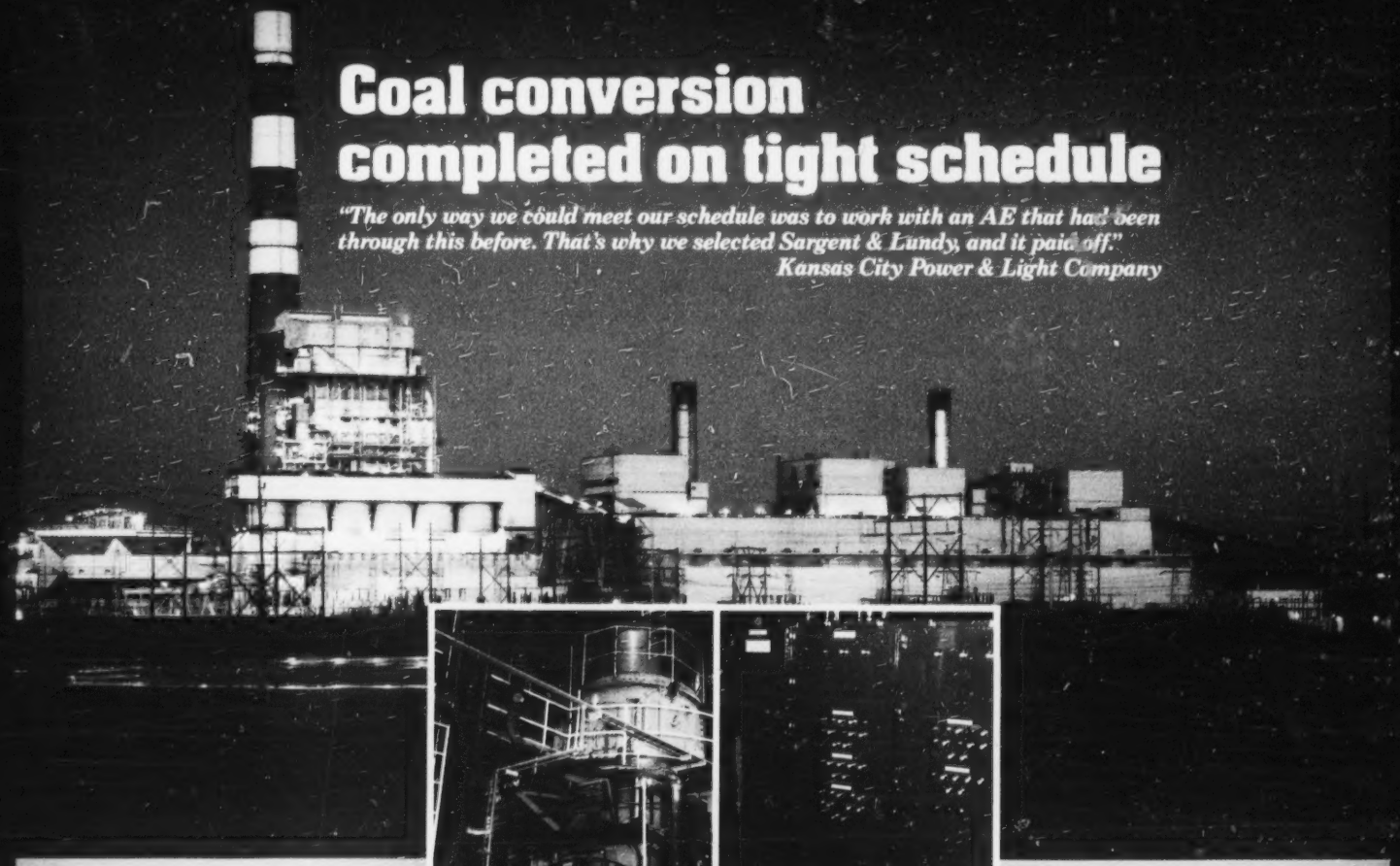
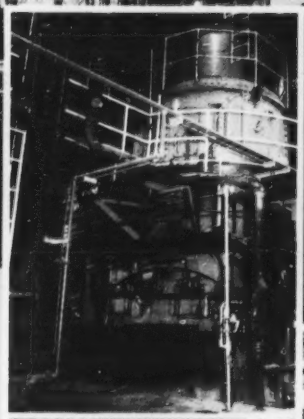
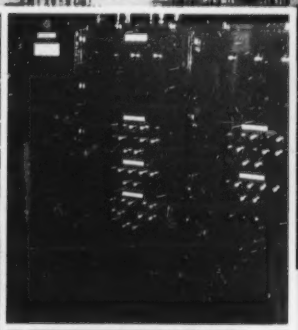
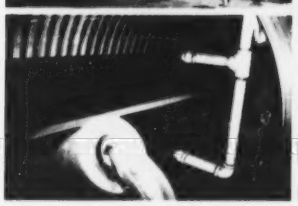
"The only way we could meet our schedule was to work with an AE that had been through this before. That's why we selected Sargent & Lundy, and it paid off."
Kansas City Power & Light Company









When Kansas City Power & Light identified an opportunity to purchase less expensive low-sulfur coal for their Hawthorn and Montrose stations, they acted quickly. The contract was signed and the new coal was scheduled to start arriving at the Hawthorn station within one year. Since these plants originally were designed to burn high-sulfur coal, extensive modifications were required to the coal handling system and related equipment and structures prior to receiving the new coal at the plant.

A KCPL team was mobilized to spearhead this program. They visited other plants where similar high-sulfur to low-sulfur coal conversions had been made. From these visits, the KCPL team became aware of Sargent & Lundy's extensive experience with low-sulfur coal conversions and selected Sargent & Lundy to assist them with their Hawthorn and Montrose conversions.

The conversion projects were approached in two phases. During the first phase, design concepts, budget estimates, and schedules were prepared. After approval by KCPL management, S&L was authorized to proceed with the second phase consisting of design and procurement to support construction. At Hawthorn, only nine months remained from authorization of detail engineering and procurement to a previously scheduled 4-week maintenance outage during which the modifications were to be completed. Through careful planning and close cooperation by KCPL, S&L and the onsite contractors, the engineering and construction work was completed on schedule. A similar program is underway for the Montrose station.

The Hawthorn and Montrose low-sulfur coal conversion projects are examples of the results that are possible when a Sargent & Lundy betterment team tackles a challenging station modification.

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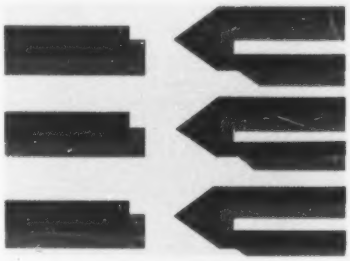

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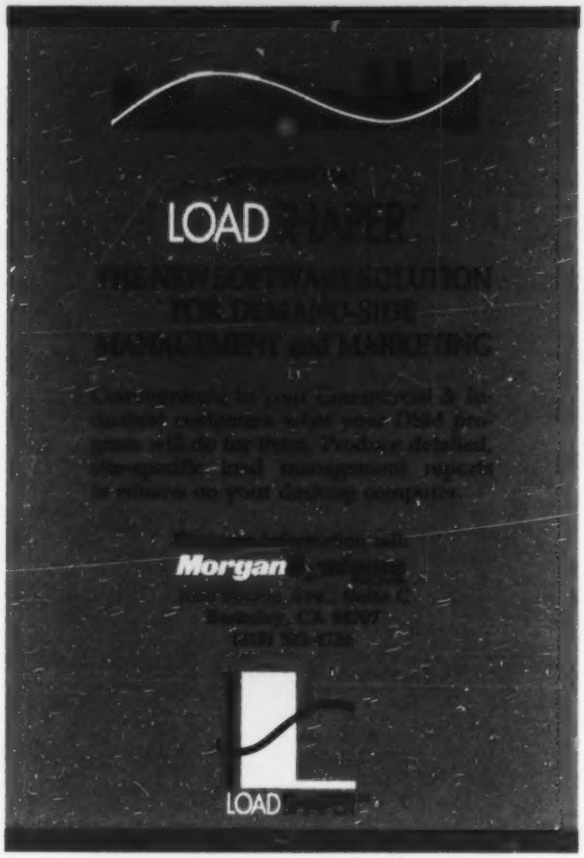
Cover: Will the price of oil be $30 or $10 per barrel in 1990? Decision analysis can help utilities plan for that uncertainty and others, p. 8. Photo by Stacy Pick/Uniphoto.



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A PERIODIC REPORT FROM BURNS AND ROE — SUMMER, 1987

Burns and Roe's EWD—a shortcut to solving electrical problems

Al Bagocius: "Time is extremely expensive during an unplanned outage."

When an operating power plant experiences an unplanned outage, the utility's primary concern is to get back on line in the shortest possible time. This usually involves three steps:

- Identifying the cause of the failure;
- Selecting the appropriate remedial action;
- Determining how that action will be carried out.

Two different inputs are used in this process: plant documentation (such as design drawings) and engineering talent.

Downtime means loss of revenue, so both inputs must be used as effectively as possible. Although the best engineers can be assembled relatively quickly, they still need reliable sources of information which can be interpreted easily and accurately, and in as concise a form as possible.

Traditional detailed drawings of power plant electrical systems can be categorized as follows:

- One-line diagrams, which depict power flow, major connected equipment and circuit protection;
- Elementary diagrams, which represent circuit control systems in a ladder-type format;
- Block diagrams, which show cabling interfaces between components;
- Connection diagrams, which identify component point connections, equipment internal connections, vendor information, interconnections between devices, and field connections;
- Physical drawings, which show general arrangement, equipment and raceway layout.

Al Bagocius, Burns and Roe's principal electrical engineer, points out that traditional power plant drawings are not prepared with troubleshooting in mind. "Traditional drawings," he explains, "are usually intended to facilitate fabrication and field construction work such as bulk cable pulls, interconnections at motor control centers and panels, and raceway drawings.

"As a result," Bagocius continues, "troubleshooting a function failure usually requires checking several drawings to get a complete picture of the systems, which is time-consuming—and time is extremely expensive during an unplanned outage."

For 13 years, Burns and Roe has been using a more pragmatic approach to the problem—a concept called BRC/EWD, short for Burns and Roe Company/Electric Wiring Diagrams. The concept consolidates the information presented on traditional elementary diagrams, block diagrams and connection diagrams on one master electric wiring diagram.

EWDs aren't only intended for use in troubleshooting, says Bagocius; because they provide all the necessary electrical information in one concise document, they facilitate construction, start-up, operations and maintenance. Adds Bagocius: "They're also great for training."

Burns and Roe has prepared EWDs for five fossil-fired plants and three nuclear plants, and is now also using them for various industrial applications. For further information, please contact any Burns and Roe office.

BRC/EWD highlights

BRC/EWDs offer power plant operators these benefits:

- A single, concise format, with everything the troubleshooter needs to know on one diagram;
- A systems-oriented approach, which depicts graphically all component information to promote understanding of functional operations;
- A comprehensive presentation, which shows interface cabling, termination information and cable conductor color coding;
- Elimination of additional documentation, such as wire lists;
- Logical identification of key elements, such as vendor-supplied items with references to interfacing documents;
- A "pace setter" which reflects changes made to elementaries, cable terminations and component connections—simultaneously.

New projects

Recent power projects awarded to Burns and Roe include:

- For the **Electricity Generating Authority of Thailand**, engineering and design services, construction and start-up assistance as well as project management of a 75MW oil-fired, barge-mounted power plant;
- For the **U.S. Department of Energy**, an evaluation of the use of modular construction for the 1300MWe large scale prototype breeder;
- For **Mitsubishi International Corporation**, a study of natural convection cooling of areas within the Japanese demonstration fast breeder reactor plant;
- For **National Nuclear Corporation** of the United Kingdom, an evaluation of the use of seismic isolation for the U.K. commercial demonstration fast reactor;
- For **Electric Power Research Institute**, perform tests and evaluate seismic isolation bearings and high-temperature concrete for U.S. and Japanese breeder reactor plants;
- For **Illinois Power Company**, a review of the maintenance program at Clinton Nuclear Station;
- For **Toledo Edison**, three major Configuration Management projects at the Davis-Besse nuclear power plant;
- For the **National Bureau of Standards**, detailed design of a cold neutron guide hall for its research reactor at Gaithersburg, MD;
- For **Jersey Central Power & Light**, three projects involving engineering and design services.

Decision Analysis: Measuring the Unknowable

By quantifying the effects of uncertainty, decision-tree techniques help identify the most cost-effective hedges against risks.

Making wise business decisions is a challenge of the highest order and the *sine qua non* of a good executive. It is the most difficult aspect of management because it depends on knowing the unknowable—the future. We can reduce some of this uncertainty about the future by better engineering, more scientific information, or closer financial analysis to resolve more clearly what we know today; but nothing we can do will make absolutely clear tomorrow's events.

Is OPEC going to drive the price of oil to $30 per barrel or higher? Or, is the price going to collapse back to $10? Will regulation mandate further substantial reductions in emissions? Will there be a leak in PCB-filled equipment before it can be removed? Will customers switch to electricity even more rapidly than in the past? Or, will other fuels capture significant portions of the traditional electricity market? What will the capital cost of a contemplated power plant turn out to be? The fuzziness goes on and on.

Planning for these unknown and unknowable elements has been going on for a very long time. In fact, some of the earliest written texts report on farmers holding back part of the harvest to protect against the possibility of future crop failures, and many early civilizations developed extensive rules to assure sufficient storage of foodstuffs to carry them through emergencies. Likewise, the high risk of loss of individual merchant vessels in the seventeenth and eighteenth centuries led to development of risk sharing through insurance pools. By trial and error, builders of houses and defensive walls learned how to reduce the risk of structural failures, spawning rules of thumb to be applied by the civil engineer who followed.

These responses to uncertainty (delaying use of some grain, developing and investing in food preservation, utilizing insurance, adding extra structural material) demonstrate the practical lessons of investing resources to hedge against uncertain events or the risks associated with uncertainty.

Similarly, today's decisionmaker can protect against an uncertain future by hedging. Of course, to choose wisely how much to invest in such hedges, it is helpful to know how much the hedge is worth. And, to determine that value one must quantify the difficult to quantify—the effect of uncertainty on the decision being made. Only then can decisions providing hedges be compared and the alternative providing the most value (avoiding undesirable outcomes at the lowest net cost) be selected.

Thus, the challenge is to find ways of adequately quantifying the effects of uncertainty. As noted earlier, many professions have developed rules of thumb to solve such problems. For example, in designing generating systems, system planners have applied a criteria that a system failure should not occur more than once in ten years. These rules of thumb reflect hard-earned experience distilled into good sense, and they are adequate as long as the fundamental economics and risks remain roughly the same. But as basic factors change, they may no longer be applicable. For example, the substantial change in the cost of generating capacity has caused some analysts to question whether this one outage in ten years should be revised to one in five or fewer years. Others suggest that our greater dependence on electric energy today means the rule should be made even more conservative, such as once in 20 years.

Traditional analysts approach such a problem by getting more information and refining the analysis to make it even more accurate. But for many factors better estimates are difficult to acquire and reaching absolute certainty is impossible. For example, in the case of the system expansion, the need for capacity is dependent on customers' future demands, and there are limits to how much the uncertainty regarding their demands can be reduced by acquiring more and better information. In the case of fuel decisions, we recognize the impossibility of predicting accurately the actions of OPEC.

One analytical answer to this challenge has been to acquire information of a different sort. Rather than trying to make an estimate

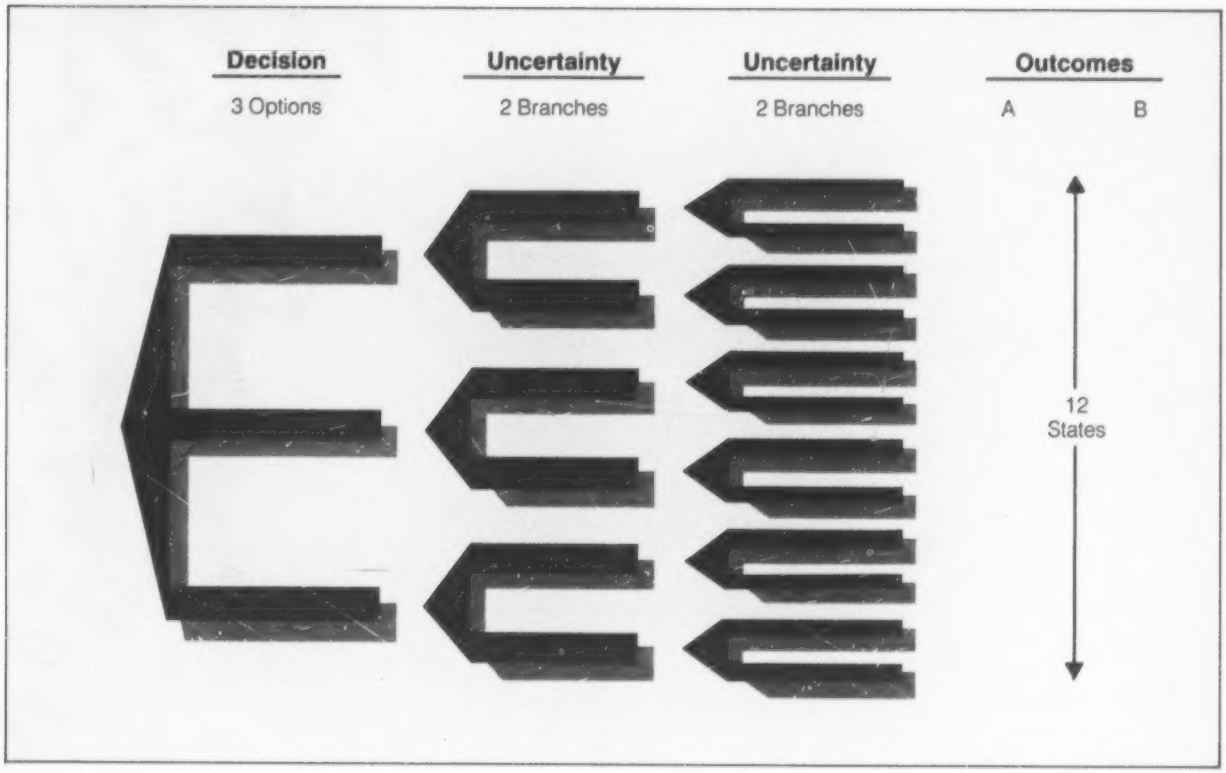
René H. Males is senior vice president and principal of Decision Focus, Inc.

Fred Kigman/Foto

Which is riskier: building new plant now or counting on load management to hold demand below capacity?

Figure 1

Generic Decision Tree



more precise, the decisionmaker looks at different possible scenarios, or searches for extreme events, or varies assumptions on important parameters. As computers have become faster, less costly, and more readily available, analysts have been able to run ever more elaborate exercises, incorporating uncertainty functions directly into calculations and producing more sophisticated results complete with probability distributions.

The problem with this solution is that many times the complexity of the analysis disguises the fact that major uncertainties of concern to the decisionmaker have not been incorporated. Many of these uncertainties are not smooth functions but rather are true discontinuities. They involve such issues as whether specific legislation will pass; whether the regulatory commission will allow the plant investment into rate base; whether there will be a spill of material into an environmentally sensitive area. Either these events occur or they do not.

Over the last two decades techniques for dealing with this kind of decisionmaking problem have been refined and are now becoming used more widely. Identified under many rubrics, they are best known as decision trees or decision analysis. The essence of these techniques is 1) to identify clearly the decision that is to be made, 2) to isolate those uncertainties of most importance to the success or failure of the decision, and 3) to state clearly the objectives by which success or failure will be measured.

Figure 1 demonstrates the full structure of a typical decision tree. Each option is evaluated against the uncertainties that could affect its outcome in a significant way. The number of possible outcomes is a function of the number of options and the number of uncertainties. Thus, in the example used here, there are 12 possible final states (3 options × 2 possible states for the first uncertainty × 2 for the second = 12).

While structuring a decision tree is deceivingly simple, the challenge is to develop one that really captures the essence of the decision problem without distracting unnecessary details. Equally challenging are determining the likelihood of events and quantifying outcomes without incorporating the intrinsic biases we all have. Training and experience provide the knowledge needed to structure the analysis appropriately and to secure the unbiased estimates needed for the calculations. Interpretation of the initial analyses can then lead the experienced practitioner to distill the framework to its essential elements, mirroring the concerns of the decisionmaker.

Three brief examples can best describe how this process works and suggest the range of utility problems to which decision analysis can and has been successfully applied.

Underground Storage Tanks

Most utilities have dozens of underground tanks used to store products more safely. Many contain gasoline or diesel fuel; others contain solvents used in machine shops; still others have been used to store waste oil.

Within the last few years, concern has grown that such tanks may leak, contaminating soil and possibly groundwater as well. If a leak occurs that necessitates extensive clean-up, these tanks can become a major cost to a utility. Even more of a concern, as a number of firms have learned, is the possible liability for health effects attributed to the leaked product contaminating the water supply.

Mitigation strategies are available to reduce the possibility of such undesired outcomes. One alternative is to test tanks regularly for leaks. However, such tests are

Northeast Utilities

As part of its program to manage underground storage tanks, Northeast Utilities installed groundwater monitoring wells.

costly. Moreover, they are imperfect; they may fail to detect some leaks while falsely indicating that some good tanks are leaking. Another alternative is to install continuous monitoring devices measuring input, output, and current inventory so a leak will show up as missing product. However, such devices are expensive and none are perfectly accurate. There are several different types of tanks that can be used: bare steel, fiberglass, steel lined with fiberglass, concrete encased, double-walled, etc. The more expensive types are more reliable but only if properly installed.

Having suffered one very expensive clean-up operation, one utility was considering replacing each of its five dozen tanks with the most reliable version. The tank manager, however, thought this was needlessly expensive. An advisor suggested replacing all tanks after ten years of use, but the manager observed that the tank that had necessitated the expensive clean-up was only six years old.

This problem provided an excellent application of decision analysis. There seemed to be more alternatives than there were tanks, but by forcing a disciplined look at decision alternatives, the choices were boiled down to four generic options:

- Replace tanks only after a demonstrated leak
- Replace tanks on a time schedule
- Test tanks and replace only when they leak
- Replace tanks at high risk

(A second question followed the first: what kind of tank should be used? This decision was analyzed separately but is not discussed further here.)

The question of which uncertainties should be considered was troublesome too. Sensitivity analyses showed some to be not crucial to the choices to be made, and after many discussions and analyses the most important uncertainties were identified:

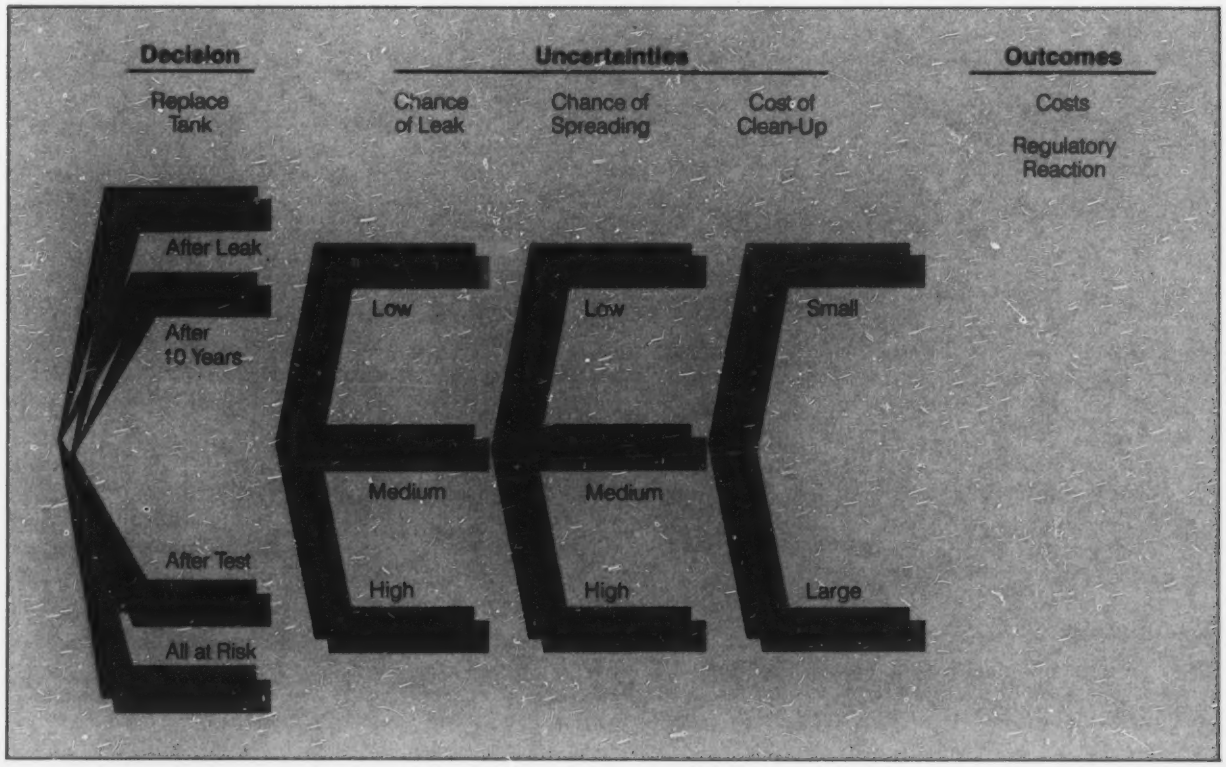
- Chance of a tank leaking—low, medium, or high
- Chance of the leak spreading to ground water—low, medium, or high
- Cost of the consequent clean-up—small or large

It turned out that these uncertainties could differ markedly depending on the type of tank in question, the type of product it contained, its physical location, and the nature of the local geology.

Finally, the measure of the decision's ultimate success or failure was taken to be the tank's life-cycle cost to the utility. Because there were four options, three possible states for two uncertainties, and two possible states for the third uncertainty, the decision tree for this problem terminated in 72 possible

Figure 2

Storage Tanks Decision Tree



outcomes ($4 \times 3 \times 3 \times 2$). Figure 2 presents the problem in an abbreviated decision tree format. (The effect of different strategies on consequent regulatory decisions also was considered.)

After the problem was structured in the decision tree format, many analyses were performed varying estimates such as the chance of a leak or the cost of the clean-up. This exercise lead to an understanding of the importance of the various parameters.

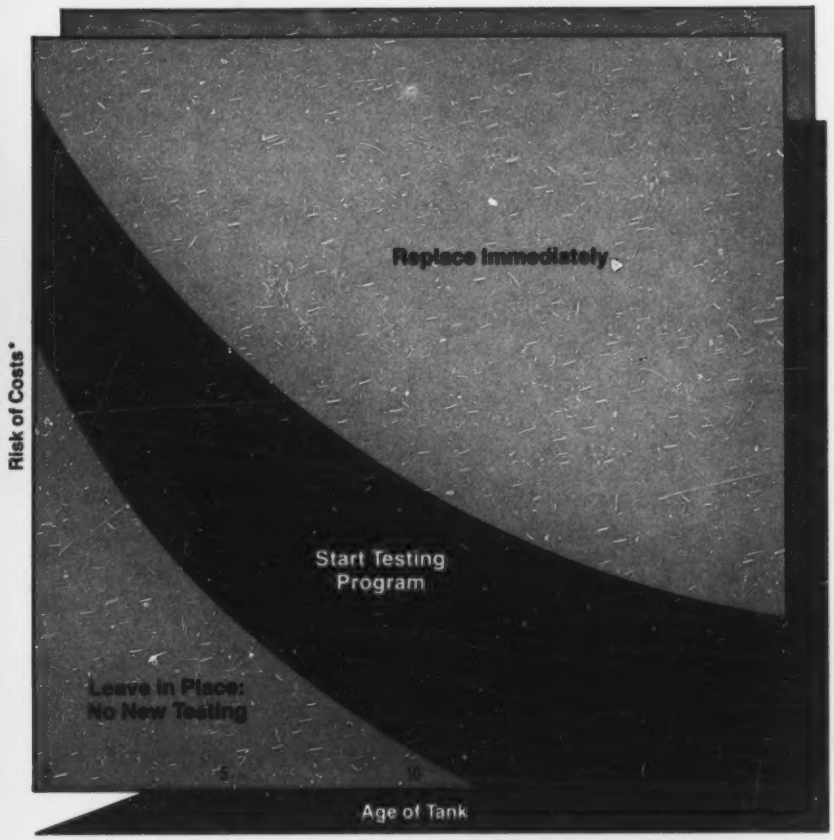
The final product, captured in Figure 3, was a decision rule that correctly reflects the manager's desire to avoid a major leak and yet keep the cost within bounds. Half of this utility's tanks need not be tested in their early life. As these tanks age, they should be placed in a testing program. However, there are some tanks in sensitive locations that need to be immediately replaced by more reliable tanks; others will fall into that category as they age.

The cost to the utility over the next decade is unknown. But, given the probability information in hand, this hedge appears to be likely to save the utility $25,000 per tank over doing nothing and $10,000 per tank over replacing all ten-year-old tanks now. Consequently, when this manager went before the company's executive committee to obtain approval to proceed with the program, he was able to discuss the options in terms of risks to the company and risks to the potentially exposed population. Also, he could demonstrate that the plan remained robust as one varied assumptions about major uncertainties such as the cost of clean-up or the likelihood of leaks. These were the concerns and the language suited to the executive committee deliberations.

In addition, the manager now feels more confident about the decision he has made because its rationality can be demonstrated to the local environmental agency, and he believes the utility can explain more

Figure 3

Storage Tank Decision Rule



*based on tank location and cleanup costs if leak occurs

explicitly—and proudly—the way it has fulfilled its public responsibility.

Counting on Load Management

Since the dramatic increase in fuel prices in the 1970s many utilities have completed their capacity construction programs and are now pursuing demand-side management to keep system load below system capacity. Much analytical effort has gone into identifying and cultivating cost-effective demand-side management options, and much progress has been made. Yet, great uncertainty still remains about how much control over load growth and peaks can be achieved with demand-side management.

One executive facing the prospect of having to commit for generating capacity within the near future saw this situation as an excellent opportunity to use decision analysis. It is a problem involving a major decision with a great deal of risk: committing to a multi-$100 million investment. The problem involves major uncertainties, including the rate of load growth, the amount of offsetting conservation or load shifting that can be developed, and the regulatory treatment the utility will receive.

Expressing this situation in a simple decision tree (Figure 4) allowed the executive to focus his analysis on the unknowns central to the discussion. It was apparent that the decision would be easy if the utility knew that the cost of the new unit would be included in the rate base whatever the eventual power need turned out to be. Customers were better off hedging now with the beginning of construction. If the capacity were needed, the cost of electricity without the unit would be higher and the risks of less reliable service could be very expensive. If the capacity turned out not to be needed, the efficiency of the newer units would partly offset the additional capital costs. Stockholders would be as well off with the start of new construction provided that they were allowed to earn a return on the investment.

Still, no one at the utility could see how such a provision could be guaranteed, and it was clear that without it stockholders were at a substantial risk if construction were started and the capacity turned out to be unneeded.

The analysis also made clear that the degree of load growth and the power of demand-side management to control it were very important to the decision. Yet both these factors remained elusively impenetrable to further analysis. Only time would bring better information. This, then, made the option to defer by far the most attractive. It would allow time to gather more experience regarding load management and more insight into the demand growth of the area. However, this option was weak, even dangerous,

Figure 4

Capacity Expansion Decision Tree

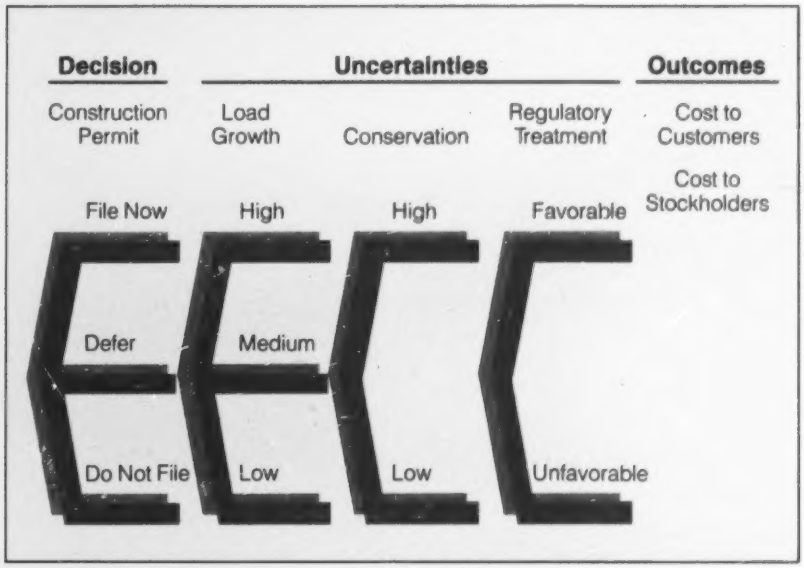
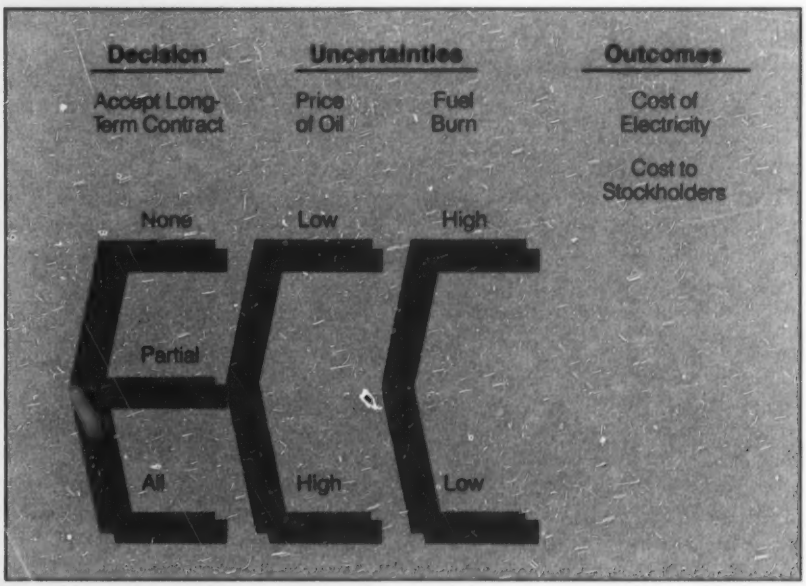


Figure 5

Fuel Management Decision Tree



if load growth turned out to be very high and load management's ability to shape and contain it turned out to be very low.

The decision finally taken was to develop a series of even more vigorous load-management programs and to begin negotiating for a power-purchase contract while deferring construction for two years. Electricity may cost customers a bit more or less than it would if the decision to build had been made now, but stockholders will be protected from a possibly costly outcome.

The major insight from the decision analysis was that additional information on customer demands in general and on the effectiveness of demand-side management options in particular will have great value. But, since this additional information can only come with more experience, hedging to gain time has great value. At the conclusion of this project, many of the participants felt that they had known this intuitively all along, but the clarity of the expression of why this was the logical strategy helped the management team come to support the decision.

Fuel Management

The shift in the cost of fuels in the 1970s caused a dramatic change in the growth of energy demand and innumerable headaches for utility executives trying to minimize electricity costs. More recently the shambles in the OPEC agreements caught a number of utilities with commitments for oil at $30 a barrel when the spot price was only $10. Now with the price meandering under $20, what is a prudent fuel management strategy?

One utility, which has a small fraction of its capacity in oil burning equipment, analyzed this problem. The utility was offered what

seemed to be an attractive long-term contract at the then current market price with the standard form of escalators. The decision, then, was whether to accept this offer or continue to depend on spot purchases.

The major uncertainty that appeared to drive this decision was whether the future price of oil would be high or low. If oil prices soared again, it seemed apparent this long-term contract would protect the utility's customers from these high costs. Conversely, if oil prices were to plummet, the utility's customers would be paying higher costs than they would have incurred without the contract, or, possibly, those costs would be imposed on the stockholders. In either case, if oil prices were to decline, the utility's management would be facing problems.

The decision analysis revealed that the focus on the oil price had failed to reveal an important factor affecting the decision—fuel burn. By recognizing that the utility's use of oil is also a major uncertainty, as shown in Figure 5, some new insights were brought to light. As the analysts elicited managers' opinions on the probability of the various states of the world, it was discovered that it was likely that fuel burn and oil price were strongly negatively correlated. Under a scenario of high oil prices, the utility will use its oil generation less intensively because the dispatch ranking of oil-fired units would be lower. Also, electricity demand is likely to be lower when oil prices are high.

These observations lead to the development of a strategy in which only a small portion of the likely oil demand was put under long-term contract. The rest is now being purchased on the spot market. This practice has allowed the company to cover customers' risk from high oil prices without placing stockholders at undue risk.

Considering the Unknowable

Although these techniques of focusing on the decision issues in a simple format are powerful analytical tools and significant aids in the decisionmaking process, they do not supplant the need for thorough technical analysis. Rather, they

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supplement them; the numbers and values that are entered in the decision tree come from the traditional applications of engineering economics, financial analysis, load forecasting, etc.

The strength of decision analysis is that it assembles and distills the results of these technical evaluations and focuses on the salient characteristics the executive wants to consider. Decision trees explicitly outline the train of thought by which one arrives at a conclusion. Linking that train of thought with the detailed analysis provides an auditable trail to document how decisions were made, which issues and events were considered.

Perhaps most importantly, the decision analysis approach may make it more likely that the executive will consider those uncertainties and future discontinuities. And, that very consideration may lead to different and better decisions.

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SUGGESTED READING

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Benjamin J. Ewers, Jr. and
Daniel J. George

SBU Management: Planning Your Place in the Market

At Northern States Power, individual strategic business units manage their own destinies.

Utilities have been subjected recently to a combination of rapidly changing and conflicting forces. They are experiencing aspects of both increased regulation and deregulation. In seeming opposition, both conservation and marketing are being encouraged. There have been large economic disturbances evidenced by periods of high inflation and interest rates followed by periods of lower rates and record federal budget deficits.

In response to this changing environment, the planning function within many utilities has been evolving from operational planning toward strategic planning and management. At Northern States Power Company (NSP), this evolution has culminated in the development of distinct operating units known as Strategic Business Units, or SBUs. Organized around product lines rather than service territories or function, each SBU is responsible for managing its own future.

The SBU form of planning offers advantages particularly useful to utility managements in their current operating environment. Its decentralized management functions and its external planning focus combine to give individual operating units the increased flexibility necessary to respond quickly and appropriately to the economic and regulatory volatility of the world around them.

Evolution of the Planning Process

The various forms of planning processes found in the electric utility industry can be reduced to four broad categories. (See Figure 1.) The operational form of planning typical of many utilities is characterized by having operational needs dictate the use of financial resources. Development of a comprehensive budget process distinguishes this form of planning, for the basic goal of the plan is to meet internal needs through the budget. The budget, in fact, becomes the plan, and management functions and responsibilities are relatively decentralized.

Corporate planning is characterized by the setting of corporate (centralized) financial goals that interact with operational (internal) goals. With forecasting as its focal point, this planning process is distinguished by the development of corporate models, corporate economics courses, and the promulgation of centralized planning assumptions.

As the rate of change in the external environment accelerated and utilities strived to keep pace, strategic planning emerged in response. Strategic planning seeks to identify the external forces that are affecting and will affect the utility and to formulate appropriate company-wide (centralized) responses. The development of strategic planning departments, financial screening models, Business Unit plans, and strategic planning models are representative of this type of planning.

Like strategic planning, strategic management focuses on planning for external forces, but in this type of planning process, management functions and responsibilities are relatively decentralized. Individual business units plan for and manage their own futures. Utilities that have formed holding companies have established the most obvious and formal corporate structure for accommodating the strategic management process, but many of the same ends can be achieved by creating an internal organizational and financial planning and reporting structure using the concept of the Strategic Business Unit. With this structure, the utility retains the flexibility to consummate the reorganization by forming a holding company, to disband the approach altogether, or to continue with Strategic Business Unit internal organization.

Strategic Business Unit Management

The restructuring of a company into business units is not a new concept. Dupont and General Motors divisionalized in the early 1920s, although most companies in the United States remained functionally organized until after the end of World War II. At that time many of the major corporations divisionalized into SBUs (often called profit centers) because they had grown too complex and unresponsive to external forces when managed through a functional organizational structure.

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Charles Gupton/Uniphoto

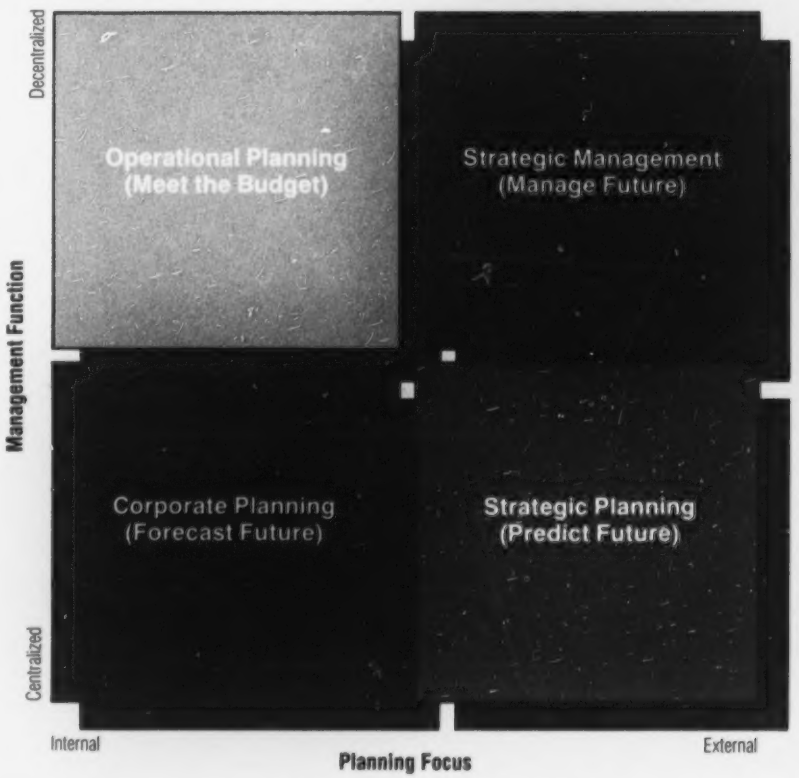
The SBU form of planning gives managers greater authority and accountability for decisionmaking.

There are several forces encouraging utility companies to follow the same course of action. One is the increasing emphasis on the deregulation of the generation and transmission operation of the electric utility business. The current national debates about cogeneration and mandatory wheeling reflect this growing push toward competition in the generation and transmission functions. Clearly, financial goals and objectives for this portion of the utility's operations should be separate and distinct from that of the retail aspect of the business. Another recent development hastening the move toward business unit management is the renewed emphasis on the contributions that marketing strategies can make toward providing energy at the lowest possible cost. The SBU management concept complements marketing strategies by focusing on external opportunities to influence both revenues and expenses.

The advantages of SBU management and financial reporting are several: 1) critical performance components can be readily identified, 2) the speed of decisions should be increased because fewer decisions have to be made at the corporate level, and 3) the quality of decisions should be improved because accountability for decisions is increased and because decisions can be made by the management team closest to the environment. Potential disadvantages do exist, however: 1) conflicts between various SBU goals and corporate objectives may arise, 2) top management will have less financial control, and 3) administrative costs could increase.

Figure 1

Management Planning Grid



The NSP Experience

Northern States Power Company is representative of utilities undergoing this transition in management planning. NSP is a multi-utility, multi-jurisdiction company operating electric, gas, telephone, and unregulated businesses in the states of Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota. NSP's initial task was to define the major operating components that could be quantified as business units. The organization of SBUs in the parent company, NSP(Minnesota), was made along three major business unit lines—Power Supply (electric generation and transmission), Electric Utility (electric distribution), and Gas Utility. The Wisconsin, Michigan, telephone, and unregulated businesses continue to be treated as bottom line contributions to corporate earnings because they are wholly owned subsidiaries with their own organizational structure or because their relatively modest size does not warrant excessive monitoring.

A look at a typical financial report helps to quantify the distinctions between centralized corporate management and strategic business unit management. In Table 1, a summarized corporate board report of financial results is contrasted with the same information developed along SBU organizational lines. The bottom line corporate earnings result is identical, but the ability to focus on those particular operations that most impact that

result is greatly improved with the SBU report.

In evaluating the assignment of revenues and costs for its three business units, NSP found it necessary to define a Management Services Resource Center. This Resource Center contains all the functions performed at the corporate level for the business units, including Finance, Law, Communications, Accounting, Personnel, and Ratemaking. Resource Centers, in providing various services, have corresponding costs that are directly assigned or allocated to the three operating business units as shown in Figure 2. This organizational structure helps to foster discussion between the resource center and the business units so that only the appropriate quantity and quality of resources are expended in meeting the company's overall objectives.

It is important to note that for SBU management to be successful, three major supporting developments must occur. First, some level of finance, accounting, ratemaking, and planning expertise must shift from the corporate offices to the business units themselves. Comparable staff reductions at the corporate level must occur if overall administrative costs are to be held constant or reduced. The transfer of employee resources to the business units is necessary to insure that the SBUs' financial goals and objectives are the result of discussions and negotiations between them and corporate management rather than merely corporate goals imposed from above.

Second, financial and accounting information has to be available by SBU identity. There are many practical problems that must be resolved in the allocation of cost and revenues within a multi-utility company such as NSP. (See sidebar, "Allocating Costs and Revenues.") Utilities that budget using the Uniform System of Accounts, as developed by the Federal Energy Regulatory Commission, have a head start since this accounting system segregates utility and function and can be utilized to develop SBU financial reports.

It is also helpful when developing SBU-specific forecasting models, the third essential to successful SBU management.

To demonstrate the type of information covered by the second requirement—financial and accounting information by SBU—it is instructive to review a typical monthly report for both the Management Services Resource Center and a strategic business unit. For this example, the Gas Utility is used.

The Management Services area is a cost center in that it does not derive revenues but has all of its expenses allocated to the SBUs. The Center's budgeted and actual costs for a sample month are shown in Table 2. Significantly more detail is available to determine whether the

Table 1

Financial Report Comparisons

Sample Corporate Report

Significant Deviations	Earnings per Share Impact
Electric Revenue Down Production Expense Up	−4
Gas Sales Down	−4
Allowance for Funds Used During Construction	−2
Total Deviation	−10
Budget	52
EPS Actual	42

Sample Business Unit Report

	Earnings Per Share (Cents)		
	Budget	Actual	Deviation
Minnesota Company			
Power Supply	29	28	−1
Electric Utility	5	5	0
Gas Utility	10	8	−2
Total Minnesota	44	41	−3
Subsidiaries	8	1	−7
Total Company	52	42	−10

cause of the expenditure deviation is an improper budgeted amount, a non-controllable expense, or a cost that management should be able to influence.

An abbreviated income statement for the Gas Utility SBU is shown in Table 3. Categorized within Operating Expenses are four cost areas including the cost of gas, expenses directly incurred by the Gas Utility and its employees, expenses incurred by the Electric Utility and assigned to the Gas Utility, and those costs previously identified as originating within the Management Services Resource Centers. The costs assigned from the Electric Utility SBU result from NSP's organizational structure, which has combination electric and gas operating divisions that report to the vice-president of the Electric Utility. Consequently, costs that are incurred by these Electric Utility employees in providing gas service are properly assigned to the Gas Utility. Identified as a fifth expense is an item labeled Investment Expense. It reflects the costs associated with Gas Utility investments including depreciation, property taxes, interest expense, preferred dividend requirement, and income taxes.

The data reflected in this abbreviated Gas Utility income statement is summarized from a fully detailed income statement as shown in Table 4. This level of operating detail provides a significantly better focus not only on the reason for the deviation in budgeted financial performance but also on the nature of the Gas Utility business within the NSP corporate organization. For example, a close look reveals that a shortfall in revenues rather than an unforeseen increase in expenditures was the major cause of the month's deviation in earnings per share. Actual operating expenses excluding fuel costs deviated from the budget by less than 3 percent, while actual revenues deviated by almost 14 percent. Further research into the revenue deviation revealed that weather was 17 percent warmer than normal; thus, weather was the major cause of the deviation in earnings per share. The financial report also shows that less than half of the Gas Utility's budgeted operating expenses net of fuel costs are directly controllable by the vice-president of that organization. This means that Gas Utility management has to negotiate with the Management Services Resource Centers and the Electric Utility SBU for the appropriate level of support necessary for the Gas Utility to achieve its financial goals.

Table 2

Management Services Resource Center Sample Expenditures

	Expenditures in Million $'s		
	Budget	Actual	Deviation
Power Supply	7.1	7.9	0.8
Electric Utility	2.4	2.4	0.0
Gas Utility	0.7	0.7	0.0
	10.2	11.0	0.8

Table 3

Gas Utility Sample Income Statement

	Millions of $'s		
	Budget	Actual	Deviation
Revenue	32.6	28.1	(4.5)
Operating Expenses			
Cost of Gas	21.0	18.0	(3.0)
Gas Operating	1.6	1.6	0.0
Assigned & Allocated			
From Electric Utility	1.1	1.0	(0.1)
From Management Services	0.7	0.7	0.0
Investment Expense	5.3	4.5	(0.8)
Available for Common	3.0	2.4	(0.6)
EPS (Cents)	10	8	(2)

John Zoiner/Uniphoto

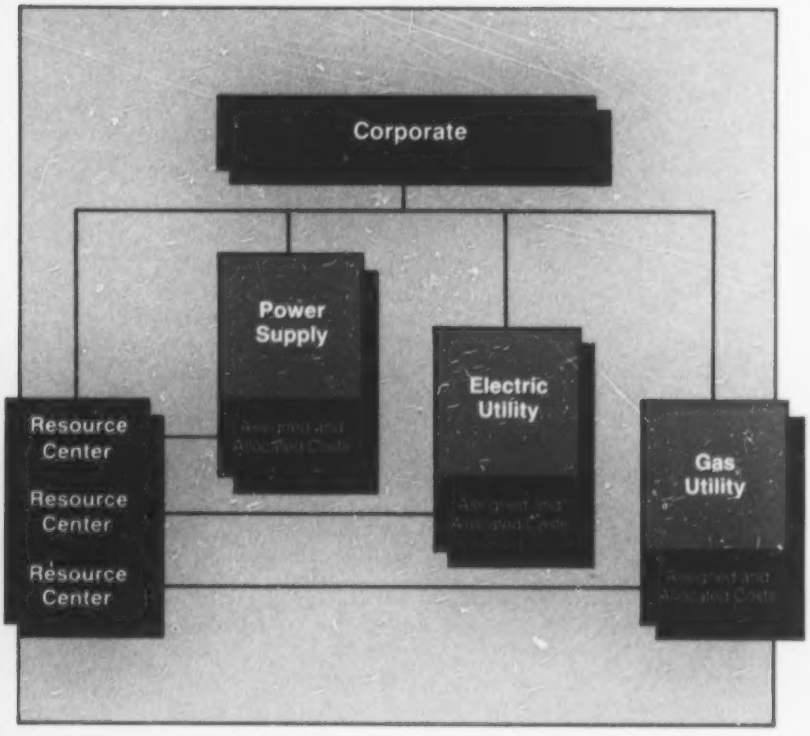
SBU managers use forecasts to evaluate current activities.

The third requirement—a method of forecasting the impact a SBU's decisions will have on its future—NSP has met by developing a simplified five-year SBU planning model that can be used to evaluate various scenarios to determine the best strategic plan to achieve a SBU's financial goals. This personal computer based model provides flexibility in the basic input variables of Sales, Other Revenues, and Construction and Operating Costs and promptly calculates the impact on the SBU's financial statements and various critical measures such as earnings per share contributions and return on investment. Three versions of this model were developed, one for each of NSP's three major business units, Power Supply, Electric Utility, and Gas Utility. The basic design of all three models is identical; however, they use different depreciation schedules, capitalization assumptions, types of other revenues, etc., that are specific to each business unit. In each model, the most recent actual calendar year serves as the base from which the next five years are forecast.

The models have been nicknamed the "IF" models by the business units because the user can manipulate the basic input variables to develop "What if . . .?" scenarios. By assuming levels of sales, expenses, etc., most likely to be realized in the near future, it is possible to estimate rough financial results. With that forecast in mind, the business unit can adjust or influence its planned activities (increase marketing to increase sales, defer construction projects, etc.) to realize more closely its desired financial performance.

Figure 2

Financial Integration of Resource Centers Into Business Units



ALLOCATING COSTS AND REVENUES

Q. What method has NSP developed to assign revenues to the Power Supply and Electric Utility business units?

A. Unlike NSP's Gas and Telephone Utilities or its unregulated businesses, which have their own distinct sales and revenues, the Power Supply and Electric Utility business units are subdivisions of NSP's electric operations. Because they share the same sales and revenues, it was necessary to develop a fair method of assigning revenues to each business unit from this common pool of dollars.

The basic principle utilized involved calculating a revenue requirement for each SBU based on cost of service data from the NSP's most recent electric rate case. In this analysis, plant and plant-related items (e.g., depreciation, property tax, deferred taxes) were split to business units according to FERC function. Power Supply was defined as containing all production and transmission functions while the Electric Utility was assigned the distribution and customer-related functions. Based on these investments and the rate of return ordered by the Commission, the necessary overall return for each SBU was calculated.

Once the return and level of operating and investment expenses for each unit were known, the revenue requirements for all the parts of the income statement were calculated, yielding gross revenues by business unit. Then, revenue items related specifically to a single SBU (e.g., Power Supply's wholesale and fuel clause revenues) were subtracted from its gross revenues to derive its sales-generated retail revenues.

It is this ratio between the two units' sales revenues that is used to split total electric revenues on an ongoing basis for reporting purposes. Consequently, any increase in revenue due to an increase in sales is shared by both the Power Supply and Electric Utility proportionately. The net effect is to allow the business units the opportunity to earn the ordered rate of return and to verify whether their own operating and investment costs have grown at a faster rate than can be supported by increases in sales.

Q. How were General and Common plant and plant-related items allocated between the Power Supply and Electric Utility business units?

A. The investment that is not directly assigned to business units by FERC function is considered to be part of the Management Services Resource Center. This level of investment is considered to be in direct relationship with the level of labor support the resource center gives the business units. Therefore, the investment is allocated to SBUs based on the fixed distribution of Management Services labor dollars directly charged to each strategic business unit.

Q. How were controllable Administrative and General (A & G) operating expenses (e.g., Law, Rate, Corporate Security, Accounting) split to Power Supply and Electric Utility?

A. An A & G allocation factor was developed from the revenue analysis mentioned earlier. This factor reflects the relationship between plant-in-service and revenues for both the Power Supply and Electric Utility and is based on data from the last litigated case in NSP's primary jurisdiction of Minnesota.

Q. How does NSP handle non-controllable operating expenses?

A. Non-controllable operating expenses for NSP comprise charges from associated companies, wheeling charges, and insurance, to name a few. An analysis of the actual data is conducted each month for each non-controllable item. For example, if the insurance item consisted of 88 percent coverage for generating plants, then Power Supply would receive 88 percent of this particular item. Items that are truly corporate in nature are allocated between Electric, Gas, and Telephone operations based on customers. Uncontrollables allocated to Electric operations must be split to Electric Utility and Power Supply. These are further scrutinized and allocated based on labor or on plant, depending on which factor is appropriate.

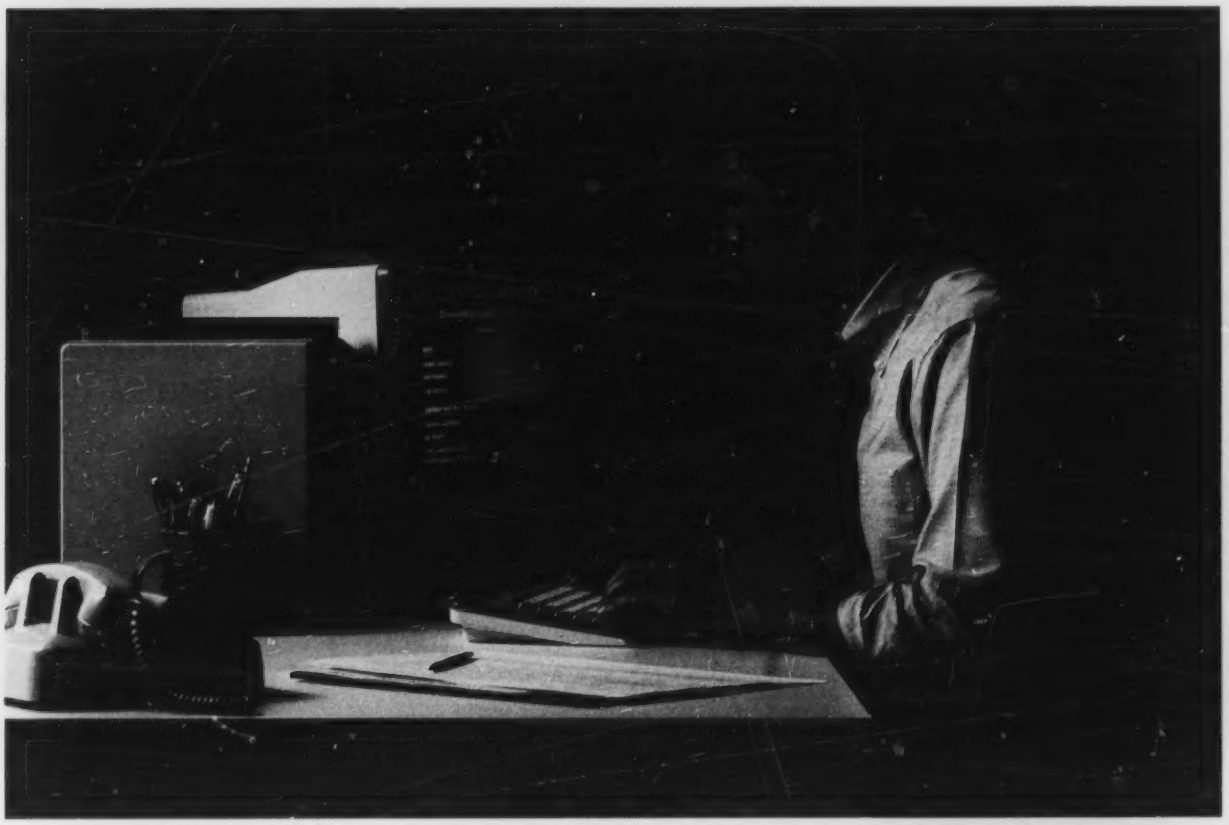
Q. If a portion of each business unit's operating and maintenance expense is allocated to it from corporate headquarters, do the SBUs really have managerial control? How can their overall performance be fairly evaluated?

A. Of necessity, a certain level of resource center services will always exist. However, the amount of these common services eventually will be cut to a minimum as business units develop some of these functions internally and agree to do away with those that are no longer valuable. Those services that remain must be allocated to each business unit by some mutually agreed upon method so all costs will be accounted for. That is the only way that management can be fairly evaluated.

Table 4

Business Unit Financial Report Gas Operations—Sample Month
(Dollars in Thousands)

	Current Month				Year-To-Date			
	Budget	Actual	Deviation	% Deviation	Budget	Actual	Deviation	% Deviation
Total Operating Revenues	$33,312	$28,669	$(4,643)	−13.9%	$181,792	$186,313	$4,521	2.5%
less: Gross Earnings Fees	643	534	(109)	−17.0%	3,377	3,399	22	0.7%
Revenues	$32,669	$28,135	$(4,534)	−13.9%	$178,415	$182,914	$4,499	2.5%
Operating Expense								
FUEL	$20,983	$17,975	$(3,008)	−14.3%	$127,969	$128,469	$ 500	0.4%
Production	214	159	(55)	−25.7%	852	655	(197)	−23.1%
Transmission	65	63	(2)	−3.1%	265	245	(20)	−7.5%
Distribution	911	1,028	117	12.8%	3,558	3,979	421	11.8%
Customer Accounting	21	60	39	185.7%	82	244	162	197.6%
Customer Information	190	99	(91)	−47.9%	752	381	(371)	−49.3%
Sales	13	15	2	15.4%	49	81	32	65.3%
Administrative & General	244	215	(29)	−11.9%	1,001	841	(160)	−16.0%
Total	22,641	19,614	(3,027)	−13.4%	134,528	134,895	367	0.3%
Gas Expense from Electric Utility	$ 1,051	$ 993	$ (58)	−5.5%	$ 4,175	$ 3,927	$ (248)	−5.9%
Gas Expense from Power Supply	$ 15	$ 7	$ (8)	−53.3%	$ 59	$ 90	$ 31	52.5%
Operating Expense from Management Services	$ 610	$ 613	$ 3	0.5%	$ 2,500	$ 2,712	$ 212	8.5%
Total Operating Expense	24,317	21,227	(3,090)	−12.7%	141,262	141,624	362	0.3%
Operating Expense Excluding Fuel	$ 3,334	$ 3,252	$ (82)	−2.5%	$ 13,293	$ 13,155	$ (138)	−1.0%
Investment Expense								
Depreciation	$ 772	$ 735	$ (37)	−4.8%	$ 3,069	$ 2,927	$ (142)	−4.6%
Property Tax	678	653	(25)	−3.7%	2,710	2,614	(96)	−3.5%
Provision for Deferred & Net ITC	367	367	0	0.0%	1,338	1,338	0	0.0%
Federal and State Income Taxes	2,958	2,194	(764)	−25.8%	13,881	16,119	2,238	16.1%
AFUDC	(2)	0	(2)	−100.0%	(6)	(288)	282	4700.0%
Interest Expense	415	402	(13)	−3.1%	1,688	1,652	(36)	−2.1%
Preferred Dividend Requirement	64	62	(2)	−3.1%	256	253	(3)	−1.2%
Total	5,252	4,413	(839)	−16.0%	22,936	24,615	1,679	7.3%
Investment Expense from Management Services	$ 76	$ 81	$ 5	6.6%	$ 293	$ 291	$ (2)	−0.7%
Investment Expense	$ 5,328	$ 4,494	$ (834)	−15.7%	$ 23,229	$ 24,906	$1,677	7.2%
Total Expense	$29,645	$25,721	$(3,924)	−13.2%	$164,491	$166,530	$2,039	1.2%
Available for Common	$ 3,024	$ 2,414	$ (610)	−20.2%	$ 13,924	$ 16,384	$2,460	17.7%
Earnings Per Share	$ 0.10	$ 0.08	$ −0.02		$ 0.45	$ 0.52	$ 0.07	



To forecast the impact a SBU's decisions will have, Northern States developed a five-year planning model for personal computers.

It should be stressed that these models were designed to show general trends and relationships. They do not attempt to duplicate the level of detail or refinement that is achieved through mainframe computer corporate models. For example, NSP's models have a limited capacity to incorporate data bases of plant and plant-related items by vintage. Therefore, it was necessary to develop a method of calculating plant balances and plant-related items associated with new and old construction expenditures. From research by NSP's Depreciation Studies department, base-year levels of plant-related items (book depreciation, tax depreciation, etc.) were calculated on all existing plant. Then plant-related items as-

Table 5

Summarized Planning Model Output for Gas Utility

IF Model—Gas

	Base Year	Year One	Year Two	Year Three	Year Four	Year Five
Sales (MMCF)	60,796	59,637	59,273	59,273	60,097	60,097
Revenue	333,494	336,635	338,385	338,913	344,031	344,031
Purchased Gas Exp	257,766	249,223	248,117	248,117	251,566	251,566
Non-Gas Exp	61,109	70,670	72,656	72,616	74,165	74,786
TOTAL Exp	318,875	319,893	320,733	320,733	325,731	326,352
Operating Income	14,619	16,742	17,612	18,180	18,300	17,679
Net Income	7,867	10,199	10,380	9,697	9,656	8,609
TOTAL Investment	156,994	163,295	168,818	171,461	175,678	180,774
ROI	9.3%	10.3%	10.4%	10.6%	10.4%	9.8%
ROE	11.0%	13.8%	13.9%	13.0%	12.7%	10.8%
EPS	$ 0.26	$ 0.33	$ 0.33	$ 0.31	$ 0.31	$ 0.27

sociated with new construction expenditures were calculated and added to the "base" plant to provide a forecast level of plant-related items.

This method works extremely well unless there is a great disparity in depreciation rates. For example, Power Supply depreciation rates range from as low as 2 percent for Hydro and transmission plant to 5 percent for peaking plants. One method to circumvent this problem is to build a forecast model allowing the user to specify projects in which construction expenditures are identified by type (i.e. fossil plant, hydro, etc.) and corresponding tables are used to calculate the plant-related items. Another method is to look at five to ten years of construction history and develop weighted ratios.

NSP's menu-driven models were designed for use by officers as well as analysts in examining various operating and investment options open to the SBUs. Table 5 displays the type of hypothetical results that can be used to evaluate various strategic plans.

Managing the Future

The planning function within corporate organizations is an evolutionary process. The current movement toward SBU management among some utilities reflects the realities of today's operating environment. In general, there is a strong trend toward deregulation, and utilities undoubtedly will continue to feel the impact of increased competition.

It seems apparent that the utilities that will emerge as the leaders in the industry will be those utilities with the foresight to "see" the future, the flexibility to make the timely changes necessary to succeed in a competitive market, and the willingness to let go of obsolete dogmas and to embrace innovative ideas. Strategic Business Unit management may help utilities respond effectively to these challenges by giving operating units more control over their own financial destinies.

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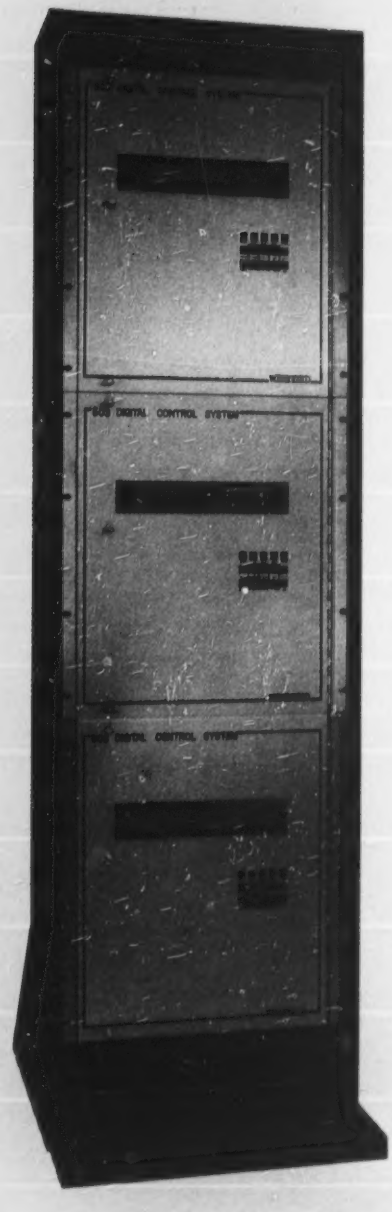

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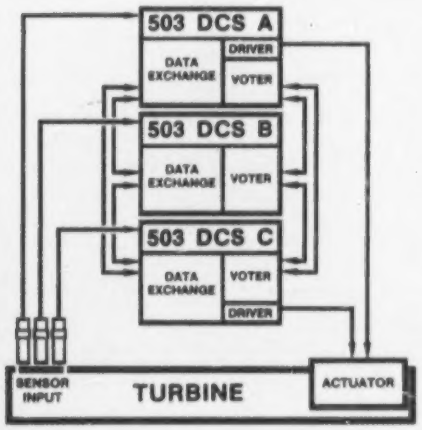

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The Strategic Dimension of Corporate Communications

A five-part company-wide strategy provides the frame for integrating communications from various departments into a meaningful whole.

In his intriguing book, *The Man Who Mistook His Wife for a Hat,* Oliver Sacks describes a patient totally unable to recognize some perfectly ordinary objects. Given, for example, a glove, he could list and describe each of its features, but could not make the "jump" to seeing it as a glove. It was as if his visual world were composed of little pieces of a jigsaw puzzle, pieces that could never be organized into a meaningful whole.

Sometimes, corporate communications practices can remind us of this tragic patient. Without a company-wide communications strategy, coherent connections between what is said or released (or even believed) by different groups in the organization can be hard to find; they might not even exist. Departments or other units in the corporation, each quite intent on speaking from its own fund of expertise, may have little sense of how their corner of the world fits in with what the organization believes or thinks it needs to say to its various publics. Fracture rather than focus becomes the norm.

It is odd that organizations that would never tolerate such confusion in their business plans or human resource practices seem perfectly comfortable with this chaos in their communications. Many, no doubt, have not given it much thought. Others might have reflected on the disarray and concluded that, like death or rock video, it is an unavoidable state of affairs.

Communication is a risk-taking enterprise under even the best of circumstances. Lovers misunderstand one another, parents and children notoriously pulse at different frequencies, friends misinterpret each other's motives. To get that risk under some control, to reduce the probabilities that things misfire or that messages are warped in meaning, is even a more imperative agenda item for corporations. Different publics constantly draw conclusions about what companies believe, what they are really committed to, and why they take the positions they publicize. The consequences of doubt, misinterpretation, or lack of credibility are extremely serious to the corporation's present and future.

Of course, one apparent way out of the dilemma is to avoid communication at all costs—a tactic that has surely been tempting to most of us at one time or other. File the legal papers required, issue the necessary government reports, smile, and keep looking at your shoes. But trying to avoid meaningful communication with our publics—our employees, our customers, government officials, shareholders, community groups—is itself a clear communicative act. Not communicating can send the most perverse messages of all, and publics are left—almost forced—to fill in the blanks in the most damaging way.

We might, of course, try the introduction of a "party line," put everyone's heart and mind in lock step, all singing one tune with one set of lyrics. But then, it is hardly necessary to say, we are talking about scripting, not communicating—one reason dictatorships never win awards from the Public Relations Society of America.

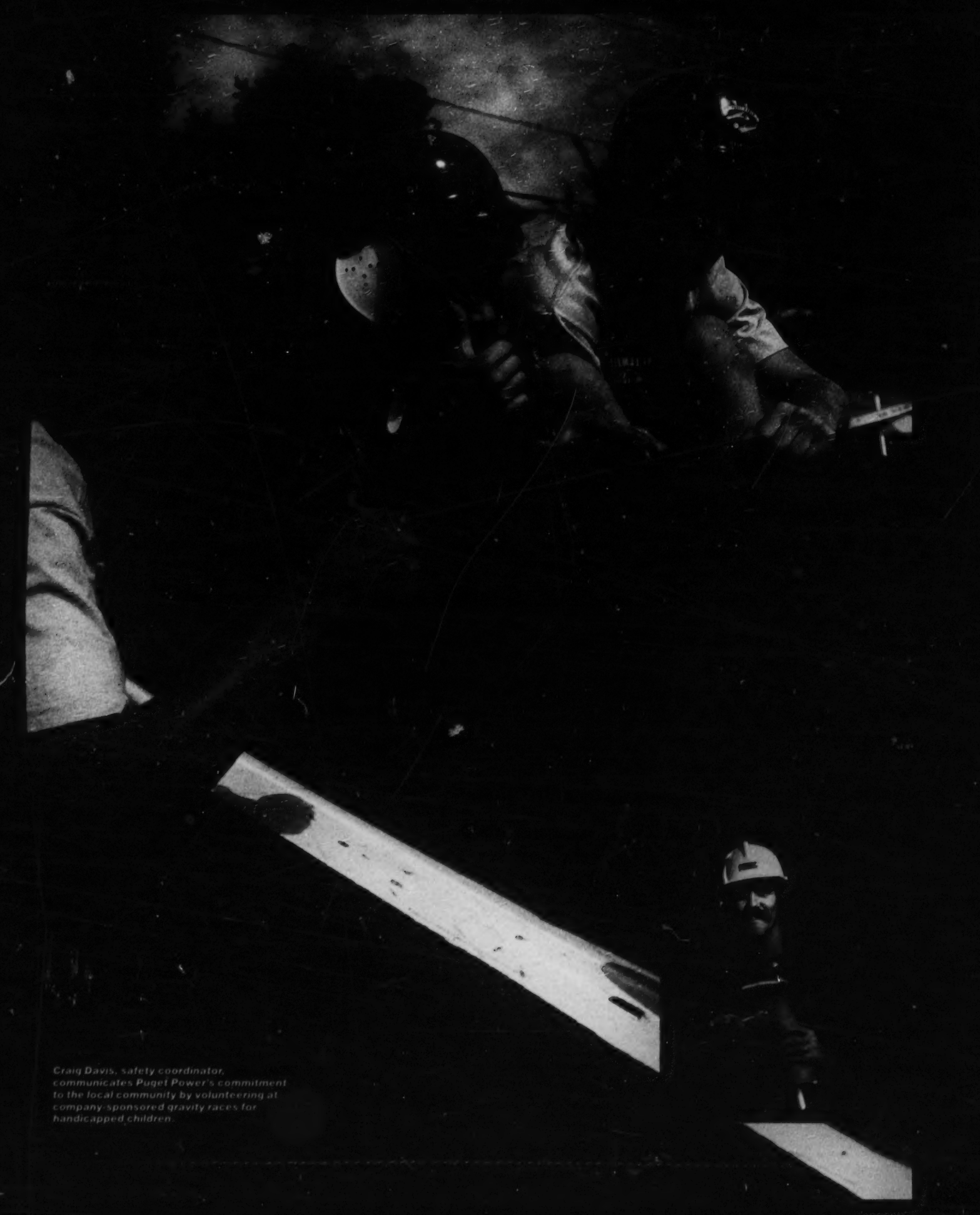
Fred Abbate is general manager of corporate communications at Atlantic Electric.

A Strategic Option

A better approach, but not an easy one, is to develop and implement a communications strategy for the organization. Now, the word *strategy* has been notoriously overused in the last few years. Putting the term *strategic* in front of any noun has become a way of signifying its importance. (People used to deploy *Freudian* for similar effect.)

To talk about a communications strategy in this case, however, is to speak with the proper sense of the concept: a high-level, visible, directed vision for the organization that acts as a framework for management decisionmaking, and within which actual practices can be evaluated. In this case, the decisionmaking and the practices are about the nature and types of communications with the organization's various publics. Such a communications strategy should have specific strategic objectives and a

Puget Power/David Waterstone



Craig Davis, safety coordinator, communicates Puget Power's commitment to the local community by volunteering at company-sponsored gravity races for handicapped children.

clear focus on targeted publics. It should provide process guidelines for communications and spell out methods for translating strategy into action and for monitoring and measuring the progress made.

Strategic Objectives

These are the ultimate "whats" of corporate-wide communications activities; in effect, they are what the corporation is trying to say and show about itself whenever it communicates to a public, irrespective of what it is specifically trying to accomplish by a particular communication. Some examples:

- Demonstrate that our company and its employees genuinely care about our customers' problems and needs.
- Show employees that they are valued members of our company whose contribution is taken seriously and whose safety and welfare are vitally important.
- Provide helpful and timely information about our programs and policies and encourage public participation in the planning processes we use to achieve our goals.

The objectives are not pious platitudes and should not be drawn up in an ivory tower or a back room. They should be stated as actionable items ("demonstrate," "show," "provide," etc.) and, more importantly, should truly and honestly capture the organization's basic beliefs about who and what it is and does. The corporation's management, staff, and others should be consulted for their ideas, and the organization's past and current practices should be examined. The final articulation of the objectives should reflect the ideas the company is really trying to embody in its relationships with its publics. A good strategy should always begin with this important step.

Recognizing the value of face-to-face communication, New York State Electric & Gas meets customers at the state fair and uses a mobile office to reach rural customers.

Individuals and units in the corporation can use the objectives both as yardsticks (to assess how actual practices conform to them) and as catalysts to stimulate thoughts about what more can be done to improve communications with particular groups.

Public Focus

The publics with whom the organization needs to interact need to be known, listed, and analyzed into subgroups on the basis of their issues, concerns, and expectations. There are several meaningful (and many meaningless) ways to do this, but clearly some publics are very critical for success (regulators, customers, employees, etc.), while others are less critical (industry associations, community groups, etc.). The latter, of course, might loom large at particular times on specific issues, and the strategy should list them as potential problems or opportunity areas.

This segment of the strategy is more revisable than others for the simple reason that public concerns, like winds, change velocity and direction. Still, the critical publics do not change significantly unless the organization substantially changes the nature of its business.

Where the issues, concerns, or structure of a public or its subgroups are not clearly known, the strategy licenses research on the matter. A large part of our failure in communication occurs because we have assumed things about our target audiences that are sometimes flatly untrue, conclusions based on "gut feel" rather than real evidence.

Process Guidelines

Direction about the recommended "hows" of communication, underscoring the best methods to communicate with all publics, is an important part of strategy. Guidelines serve as a checklist against which to review our ways of communicating. Examples:

- Targeted approaches are to be used instead of mass communications, when possible, practical, and cost effective.

New York State Electric & Gas

■ When possible, practical, and cost effective, personal contacts on issues of major concern to the organization are to be preferred to other approaches.

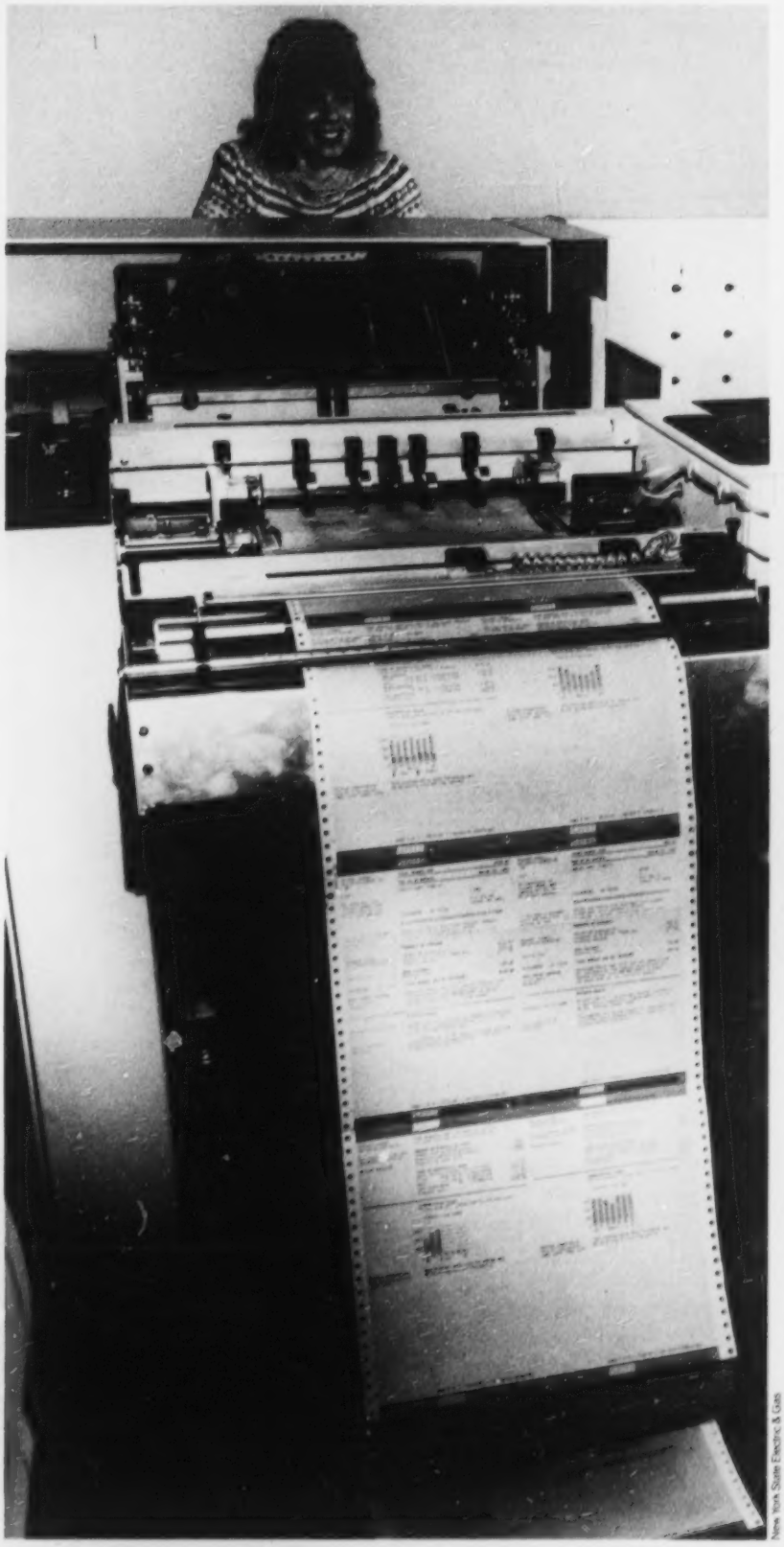
■ In general, two-way communications are to be preferred to one-way communications.

These may be well-known ideas about effective communications, but adopting them as part of the strategic plan of the corporation puts them on a significantly different level. For one thing, they now stand as corporate commitments, essential elements of our practices, rather than as "nice-to-have" approaches in the organization's communication efforts.

Translation

In order that a communications strategy not quickly become a vessel for the fossilized remains of noble intentions, it must prescribe a clear way of putting itself into practice. (What Chesterton said of Christianity applies here: good strategies do not fail; they aren't actually tried.)

Careful work has to be done to get a strategy to be used. One method is to make available to corporate managers and decision-makers a matrix for putting the principles and concepts into practice. Action commitments need to be made by each unit of the organization; lists of specific goals have to be generated that show substantive ways in which corporate groups will



New York State Electric & Gas

Before switching to a new two-page bill, New York State Electric & Gas tested it with customers to make sure the extra information printed on it makes the charges easier to understand.

communicate with their specific publics. A department may resolve, for example, to improve the way it underscores the importance of safe working procedures for its employees, to increase its contributions to community projects, or to show shareholders more concrete evidence of good managerial planning.

Workshops can be conducted for this purpose, and matrices, other materials, and consultative support can be made available to managers to help them focus on audiences, use appropriate types of messages and media, and keep proposed activities coherent with what the strategic objectives seek to accomplish.

These unit-specific communication goals and implementation practices are best set up at the same time the unit sets its other goals. Managers must become aware that their job requires managing not only strictly operational issues but also the communication dimensions of those issues. These managers typically will need the help of the communications people in the organization (much as they would need the training group to accomplish certain ends, for example). But the responsibility for getting these communication goals accomplished should lie principally within their unit.

Monitoring and Measuring

Reviewing the practices and programs of the corporation and measuring the effectiveness of the strategy through surveys and other indicators are essential if there is to be meaningful strategic implementation. Each individual manager must be held accountable for progress. Overall yearly (or more

frequent) reports need to be made to assess the strategy's impact on the communication activities of the organization. In the light of these reports, the strategy should be evaluated and adjusted if necessary.

The Warp and Woof of Reality

It's no secret that the "real" world is not a strategically organized place, and anyone who has tried to implement policy is better off, if more depressed, knowing in advance about the traps that lie in wait. In the case of a communications strategy, there are surely going to be difficulties, some severe and recurring, in trying to establish it as a major force in the daily decisionmaking process of the corporation.

There are, in fact, natural tensions in most corporations between implementing such a strategy and pursuing the other business at hand. Conflicts, for instance, arise when engineering or financial units try to communicate with customers or journalists in the same way they address specialists in their own fields. Two-way communication becomes difficult for these experts who often lapse into a "telling" rather than a "relating" mode when talking with the uninformed. And pressures on managers to achieve quantifiable operational outcomes may make paying systematic attention to communications practices seem an annoying distraction (or worse, as relevant to their jobs as the latest dance craze in Bulgaria).

Obviously, top-level commitment to the communications strategy will be essential to its success, as will be constant reinforcement of that commitment. And this commitment does not mean lip-service or the hot air of general memos or weak-kneed directives. The example must be set by upper management itself, and it must make it clear that it expects results based on the strategy from everyone.

At the same time, a narrow path has to be traveled here. Force-feeding of the strategy will only cause the corporation to gain weight, not enlightenment. Heavy-handed, purely top-down enforcement stands little chance of making changes for the better. As much as possible these natural tensions and

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others must be overcome without falling into the regimentation of the "party line" mentioned earlier. One defining feature of a good strategy is that it allows for diversity while still holding firm in its sense of direction and larger framework. It can accommodate the energy of these natural tensions, without letting them run amok.

Nevertheless, some procedures will probably need changing; perhaps a centralized clearance process through the corporate communications group might have to be instituted, or consultation with it might be required for particular types of communications. The aim of such procedures should be to demonstrate to as many managers as possible how support for and improvement of their projects under the aegis of the strategy's protection can take place. There's no customer like a satisfied customer.

No doubt, there are organizations for which such a communications strategy will not work, and the reasons are probably too varied to list intelligently. But the belief that there is no need to have such an approach to communications or that more is to be lost in energy than gained in result by implementing a strategy is in general misguided. That that belief exists causes strong wonder—do some organizations really think they can ignore the current human, social, and political environments in which they are trying to succeed? ■

Manager of rates Tom Langley, a member of Atlantic Electric's 90-person Speakers Bureau, explains the company's rate design to a local business group.

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TECHNOLOGY REVIEW

"HOT" SUPERCONDUCTORS: PROMISES AND LIMITATIONS

Until early last year, superconductivity—the loss of virtually all resistance to the passage of electricity through some materials—was thought to be possible only at temperatures below 23 K (−419°F). Such materials could be maintained in a superconducting state only through the use of liquid helium. Now materials have been discovered that have been well-verified as superconducting at temperatures as high as 105 K (−270°F).

Because these new materials can be maintained as superconductors with liquid nitrogen, the costs of refrigeration equipment, insulation, and refrigerant are reduced tremendously, significantly changing the economics for practical applications. The cost of the refrigerant alone goes from $11 per gallon for liquid helium to about 22¢ per gallon for liquid nitrogen.

Development of such "hot" superconductors has the potential of dramatically changing—and perhaps revolutionizing—the electronics, electric power, and transportation industries. Their eventual impact on society could well become as important as that of semiconductors or lasers.

Research in this field is moving so rapidly that it is still hard to assess the practicality of specific applications. Outside the utility arena, the new materials will probably be incorporated into applications such as computers, digital control systems, medical diagnostic equipment, and ultrasensitive electromagnetic radiation detectors. For utilities, the materials are expected to find use in such applications as generators, motors, transformers, magnetic energy storage, circuit breakers, and fault current limiters.

The Nature of Superconductivity

Superconductivity was discovered in the laboratory about 75 years ago—long before there was any adequate theory to explain how it works. Scientists found that as some conducting materials are cooled, the frictional forces that cause resistance to electron flow suddenly drop to almost nothing at a particular temperature. In other words, electricity could remain flowing without noticeable energy loss even after the external driving force (voltage) was removed. Each type of homogeneous material, such as a pure metal, has its own characteristic transition temperature for the onset of superconductivity. In heterogeneous materials, this transition occurs more gradually and—for reasons not fully understood—at higher temperatures, if just the right combination of elements is used.

What numerous scientists all over the world have recently confirmed is that ceramic-like materials made from mixes of metallic oxides and so-called "rare earth" elements become superconducting at temperatures well above any previously considered possible. Most experiments so far have involved very small samples of these materials, which tend to be brittle and difficult to shape. The limitations on their ability to carry large currents without losing superconductivity have not yet been determined.

For these and other reasons, the full potential of "hot" superconductors for use in electric motors and other equipment remains uncertain. Two possible utility applications, however, deserve special attention—superconducting transmission lines and electromagnets.

Underground Transmission

Low-temperature superconducting underground transmission lines have already proved to be technically feasible, but their economic viability compared to other cables has not been achieved except for very large power transfer capabilities per circuit. The new higher-temperature superconducting materials offer the potential of economically competitive superconducting transmission lines. Nevertheless, the problems are still formidable, from the point where the superconducting material has been made in the laboratory to where the complex underground cable system is commercially acceptable.

The key issues that must be addressed for high-temperature superconducting material to be suitable for ac transmission include ac power loss and critical current density. The ac power loss is a hysteretic loss that gets larger as the frequency increases. This loss is the result of unsatisfactory surface properties of the superconductor, which are subject to improvement through research. Very small ac losses have been achieved with low-temperature superconductors, which is a hopeful sign for the new, higher-temperature materials.

The critical current density is the maximum current per cross-sectional area that a superconductor can carry without changing state (i.e., without becoming nonsuperconducting). Again, this is a property that can be enhanced through research, as the new superconductors are far from their ideal critical current density. For superconducting underground cables, the critical current density requirement is not much higher than the presently attainable values.

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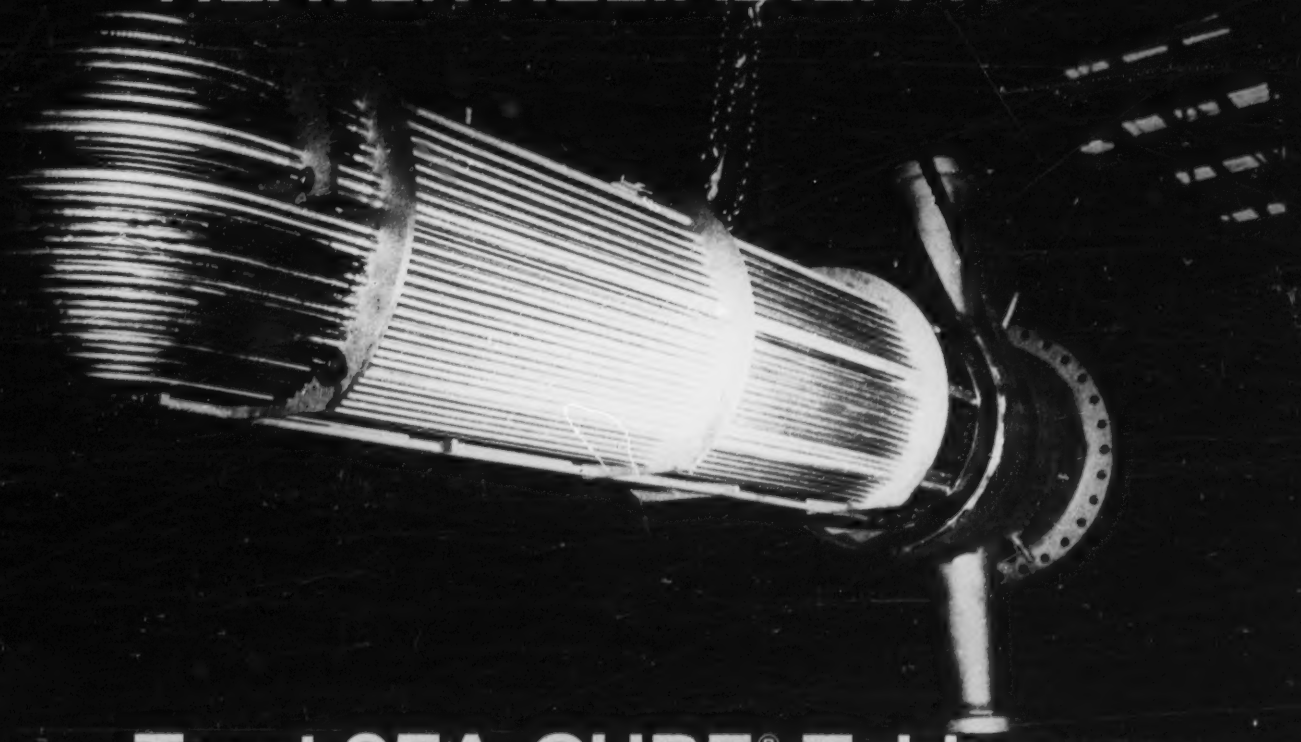

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For underground superconducting transmission lines, an integrated system would involve more than just the superconductor. In addition to questions about the fabrication and compatibility of superconducting materials, consideration must be given to such issues as the dielectric, the cryogen, refrigeration, and economic designs.

Electromagnets

Other promising utility applications, such as generators, motors, and energy storage, involve the use of superconducting electromagnets.

There are two major obstacles currently to the use of the new superconducting materials in electromagnet-based applications: first, the critical current density required is much larger than the presently attained value; second, the material at present is too brittle. The magnetic field produced by an electromagnet is a function of the number of ampere-turns of the magnet. If the current-carrying capacity of the superconducting wire is less than that of copper, an electromagnet using the new materials would be bulkier and more costly than its conventional counterpart, even without taking into account its refrigeration requirements. Also, for applications requiring a precise magnetic field and/or rapid changes in the field, the superconductor must be fabricated as very fine filaments inside a copper or aluminum matrix. The brittleness of the new materials makes this an extremely difficult production requirement.

EPRI is optimistic that these problems will be solved for the new materials (or for similar, yet-to-be-discovered materials), as has been the case for lower-temperature superconductors.

Potential Impact

The progress made in this field in the last few months has greatly increased the commercial potential of superconductors. Nevertheless, given the basic material problems still to be resolved and the many engineering problems involved in producing economical and commercially acceptable products, the introduction of this technology into real systems is at least 10 years away. However, beyond the year 2000 the technology's potential may begin to be realized in very important ways.

The impact of these new materials will extend well beyond the utility industry, particularly to the computer industry. If cost-effective and acceptable materials that are superconducting above 32°F become a reality, the impact on industry as a whole would be momentous. The experience of the semiconductor revolution has demonstrated that such sweeping changes can significantly affect the entire national economy.

EPRI's Research Agenda

Because of the breadth of potential applications and the speed with which advances are being made in this dynamic field of research, some sort of national coordination of R&D funding is likely to emerge. The Japanese government has already launched such a coordinated effort.

In this country, initial coordination is being undertaken by the Basic Energy Sciences section of the Department of Energy in the area of materials research and by the Conservation section of DOE for applications research. EPRI is now working with DOE and the National Science Foundation to hold a workshop this summer, at which a broad review of scientific progress will be made, followed by a planning session on coordination of R&D funding.

EPRI has also begun exploratory talks with leading researchers around the country to solicit proposals in areas of particular interest. These areas include research on the properties of the new superconducting materials and work on how to shape them into practical forms (wires, rods, ribbons, etc.).

Discovery of "hot" superconductors is a scientific breakthrough worthy of the name, with the potential of leading to redesign of some of the most fundamental technologies in the utility industry. EPRI intends to play a leading role in this effort on behalf of its utility members. Several years of sustained R&D will be needed, however, before the first practical applications are in utility hands, and the international competition to stake out a dominant market share is already very intense.

Contributed by the Electric Power Research Institute.

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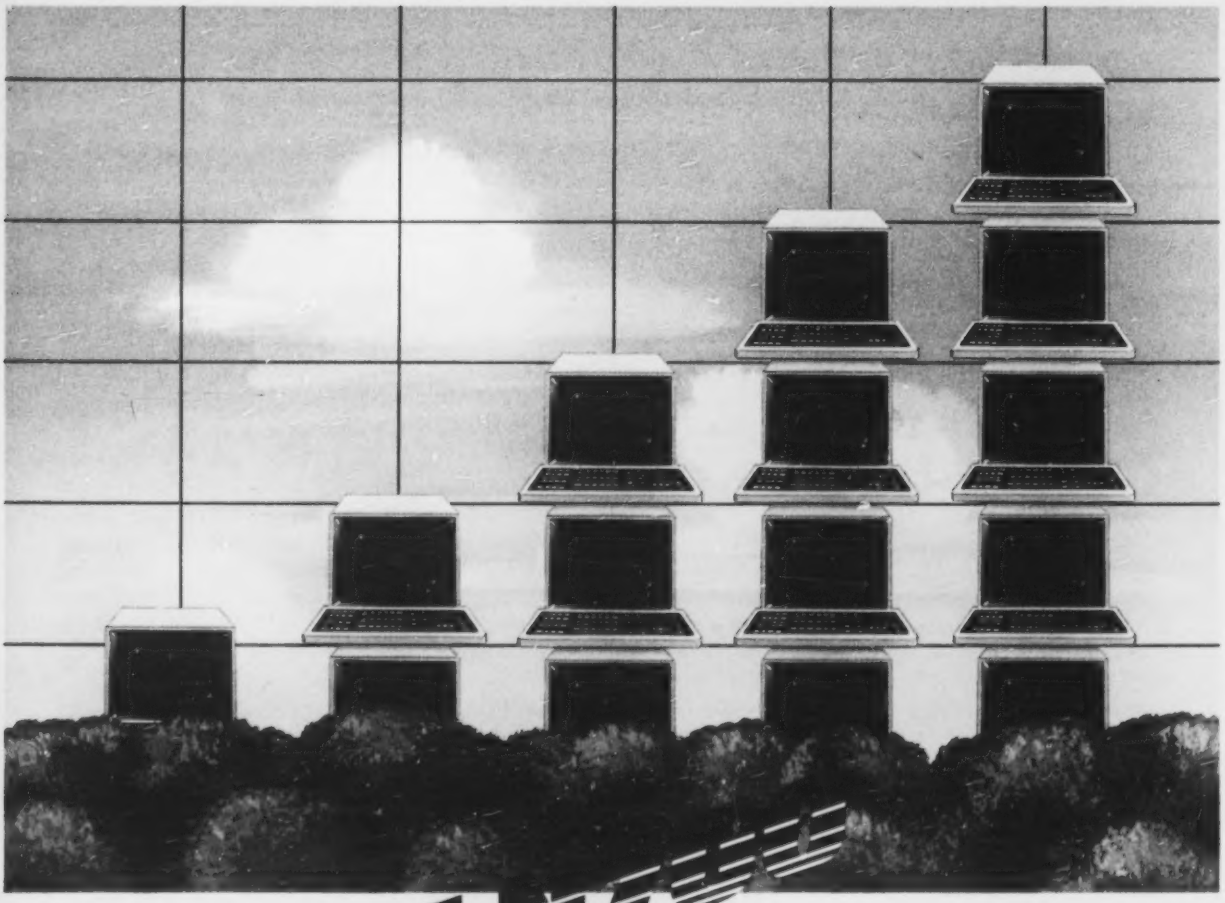

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REGULATORY REVIEW

WESTERN SYSTEMS POWER POOL BEGINS OPERATIONS

An experimental power pool linking electric utilities in 10 western states began operation in May with the hope of reducing the cost of electric power for more than 30 million customers.

The Western Systems Power Pool is designed to provide a more efficient method of distributing surplus power among its members. The two-year operation of the pool was approved March 11, 1987, by the Federal Energy Regulatory Commission in a forward-looking decision that will test the effectiveness of market-based pricing.

Energy prices will fluctuate according to market forces instead of strictly regulatory requirements. Transmission prices will also fluctuate, reflecting economic value rather than historical costs.

The Commission accepted the WSPP agreement with some minor modifications, noting that the "experimental rates are just and reasonable and comply with the underlying goals of the Federal Power Act." (Pacific Gas and Electric Company, Docket No. ER87-97, Order Accepting Experimental Rates, March 12, 1987, p.1.)

The system depends on a central computer, operated by Arizona Public Service in Phoenix, which has links to every company that belongs to the pool. WSPP members will use the computer as an "electronic bulletin board" to list availability and prices of surplus electric supplies and transmission capacity.

Potential buyers and sellers of electricity can access the computer to compare prices and availability of surplus power. When a utility finds surplus power offered at the right price, and if there is transmission capacity available for an acceptable fee (subject to a ceiling and floor), the deal can be completed by the parties involved. Electricity will then be moved over transmission lines connecting the buyer and seller. Each member whose lines are used will receive compensation.

WSPP is the largest pool of its kind in the nation. It represents a unique joint effort by public, cooperative, and investor-owned utilities to more effectively serve their customers. Its members include Arizona Electric Power Cooperative, Inc.; Arizona Public Service; Bonneville Power Administration; California Department of Water Resources; El Paso Electric Company; Nevada Power Company; Northern California Power Agency; Pacific Gas and Electric Company; Pacific Power and Light Company; Portland General Electric Company; Public Service Company of New Mexico; Sacramento Municipal Utility District; San Diego Gas and Electric Company; Salt River Project; and Southern California Edison Company.

Contributed by Pacific Gas and Electric Company.

Editor's note: The Regulatory Review in the Spring 1987 issue was contributed by Ed Comer, Assistant General Counsel, Edison Electric Institute.

FINANCIAL REVIEW

1986 EARNINGS PER SHARE UP TWO PERCENT

The investor-owned electric utility industry reports earnings per share before extraordinary items rose from $3.02 in 1985 to $3.08 in 1986, an increase of 2 percent. While total electric operating expenses rose .8 percent, total operating revenues rose 2.5 percent. (See Table 1.)

Lower fuel prices led to a $4.35 billion drop in the industry's fuel expenses last year. The ratio of fuel to total operating expenses decreased from 36.1 percent in 1985 to 31.6 percent in 1986.

Construction work in progress (CWIP) decreased 4.8 percent from $84.1 billion in 1985 to $80.0 billion in 1986. (See Table 2.) CWIP as a percentage of plant in service dropped from 33.3 to 29.0.

The industry's quality of earnings improved in 1986, continuing a trend that began in 1983. The percentage of AFUDC (allowances for funds used during construction) in net income available for common decreased from 50.3 in 1985 to 36.1 in 1986. (Percentages for 1983 and 1984 were 55.1 and 49.9, respectively.)

The drop in interest rates during 1986 allowed the industry to reduce its embedded cost of long-term debt from 10.0 percent in 1985 to 9.8 percent. Ebasco Business Consulting Company reports that the industry refunded about $11.6 billion and issued over $9.7 billion in long-term debt for new money. Equity as a percentage of capitalization rose from 41.9 in 1985 to 42.4 in 1986.

Tables 1 and 2 are based on unaudited reports submitted by a sample of investor-owned electric utilities. Accounting for approximately 94 percent of the industry's revenues and 93 percent of its total assets, the sample was adjusted to represent the entire investor-owned electric utility industry.

Contributed by the Finance Department of Edison Electric Institute.

Table 1
Investor-Owned Electric Utility Industry Statement of Income
(Millions of Dollars)
(Unaudited)

	Three Months Ending December 31,			Twelve Months Ending December 31,		
	1986	1985	% Change	1986	1985	% Change
Total Electric Operating Revenues[1]	$31,039	$29,577	4.9	$128,729	$125,547	2.5
Electric Operating Expenses						
Fuel	$ 7,359	$ 8,796	(16.3)	$ 32,284	$ 36,635	(11.9)
Other Operation & Maintenance	9,448	7,892	19.7	35,376	33,665	5.1
Depreciation & Amortization	2,990	2,711	10.3	11,530	10,302	11.9
Taxes Other Than Income Taxes	2,350	2,129	10.4	9,567	8,902	7.5
Income Taxes: Federal & Other	1,206	960	25.6	6,542	5,349	22.3
Deferred Income Taxes	1,722	1,060	62.4	5,604	4,533	23.6
Investment Tax Credits, Net	(135)	347	N.M.	1,276	1,964	(35.0)
Total Electric Operating Expenses	$24,939	$23,894	4.4	$102,178	$101,350	0.8
Electric Operating Income	$ 6,101	$ 5,683	7.3	$ 26,552	$ 24,197	9.7
Other Utility Operating Income	354	342	3.5	1,482	1,334	11.1
Total Utility Operating Income	$ 6,455	$ 6,026	7.1	$ 28,034	$ 25,531	9.8
Other Income & Deductions—Net	535	252	112.4	2,627	2,347	11.9
Allowance for Other Funds Used During Construction	989	1,189	(16.8)	4,261	5,098	(16.4)
Total Income Before Interest Charges	$ 7,979	$ 7,466	6.9	$ 34,922	$ 32,976	5.9
Interest Charges						
Interest on Long-Term Debt	$ 3,714	$ 3,753	(1.0)	$ 15,032	$ 14,470	3.9
Other Interest Expenses & Charges	276	245	13.0	966	1,100	(12.2)
Allowance for Borrowed Funds Used During Construction	(548)	(657)	(16.6)	(2,371)	(2,777)	(14.6)
Net Interest Expenses & Charges	$ 3,443	$ 3,341	3.0	$ 13,628	$ 12,793	6.5
Net Income Before Extraordinary Items	$ 4,536	$ 4,125	10.0	$ 21,294	$ 20,183	5.5
Extraordinary Items	246	(1,668)	N.M.	(158)	(1,659)	N.M.
Net Income	$ 4,782	$ 2,457	94.6	$ 21,136	$ 18,524	14.1
Preferred Dividends Declared	684	721	(5.2)	2,755	2,877	(4.3)
Net Income Available for Common	$ 4,098	$ 1,736	136.1	$ 18,381	$ 15,647	17.5
Common Dividends Declared	3,176	2,819	12.6	12,208	11,817	3.3
Additions to Retained Earnings	$ 922	$ (1,083)	N.M.	$ 6,173	$ 3,830	61.2
Average Shares Outstanding	6,054	5,870	3.1	6,028	5,735	5.1
Earnings Per Share Before Extraordinary Items[2]	$ 0.64	$ 0.58	10.3	$ 3.08	$ 3.02	2.0
Earnings Per Share After Extraordinary Items[2]	$ 0.68	$ 0.30	126.7	$ 3.05	$ 2.73	11.7
Common Dividends Per Share[2]	$ 0.52	$ 0.48	8.3	$ 2.03	$ 2.06	(1.5)

NOTES:
[1] Revenues are adjusted for intra-industry sales for resale of electricity.
[2] Based on average shares outstanding as reported to EEI by survey respondents and adjusted for stock split.
N.M.—Not Meaningful.

Table 2
Investor-Owned Electric Utility Industry Balance Sheet
(Millions of Dollars)
(Unaudited)

Assets	December 31, 1986	December 31, 1985	% Change
Utility Plant*			
Utility Plant (Including Nuclear Fuel)	$379,964	$350,324	8.5
Less Accumulated Depreciation	103,925	98,028	6.0
Total	$276,039	$252,296	9.4
Construction Work in Progress	80,042	84,092	(4.8)
Net Utility Plant	$356,081	$336,388	5.9
Investments	10,641	9,557	11.3
Current Assets	41,132	40,427	1.7
Deferred Debits	22,822	16,194	40.9
Total Assets	$430,676	$402,567	7.0
Capitalization & Liabilities			
Capitalization			
Common Stock	$ 88,694	$ 85,592	3.6
Retained Earnings	50,184	43,902	14.3
Preferred Stock	29,664	30,614	(3.1)
Long-Term Debt	158,685	148,943	6.5
Total Capitalization	$327,227	$309,051	5.9
Current Liabilities			
Short-Term Debt	$ 5,637	$ 4,352	29.5
Long-Term Debt Due Currently	6,503	6,249	4.1
Other Current Liabilities	29,440	28,117	4.7
Total Current Liabilities	$ 41,581	$ 38,718	7.4
Deferred Credits			
Accumulated Deferred Income Taxes	$ 35,824	$ 29,853	20.0
Accumulated Deferred Investment Tax Credits	16,390	15,931	2.9
Other Deferred Credits	9,655	9,014	7.1
Total Deferred Credits	$ 61,869	$ 54,798	12.9
Total Capitalization & Liabilities	$430,676	$402,567	7.0

*Includes non-electric utility plant.

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STATISTICAL REVIEW

STRATEGIC ISSUES FOR THE 1990s

Utility executives see competition as the key strategic issue of the 1990s and productivity improvement as the key to responding effectively to it, according to a recent survey conducted by Cresap, McCormick and Paget, a national consulting firm.

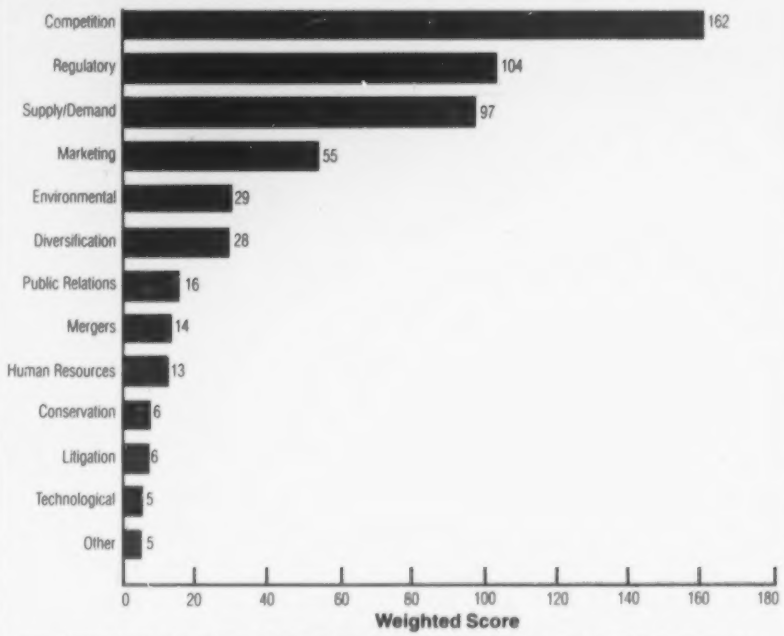
More than 60 electric, gas, and combination utilities responded to the November 1986 survey, which CMP initiated as part of its own market research program. Investor-owned and public utilities from 35 states and Canadian provinces were represented. One-fourth of the respondents were presidents, chief executive officers, or chairmen; 70 percent were vice presidents or above.

These executives were asked to identify and rank "the top three key strategic issues or forces . . . utilities will face in the 1990s." CMP assigned a weight to each rank (3 points to the #1 issue, 2 points to the #2, and 1 point to the #3) and added the selections to derive the weighted score for each issue. The weighted score was divided by the number of respondents who selected the issue to determine average rank. Thus, average rank could range from 3.0 (which means that everyone who selected the issue ranked it #1) to 1.0 (which means everyone ranked it #3).

Competition was identified as a key strategic issue by two-thirds of the sample, resulting in a weighted score of 162 (as shown in Figure 1) and an average rank of 2.45. In fact, 41 percent of all respondents selected competition as the #1 strategic issue facing the industry. All the chairmen and a majority of the presidents (66 percent), executive or senior vice presidents (80 percent), and vice presidents (74 percent) selected competition as one of the three top issues.

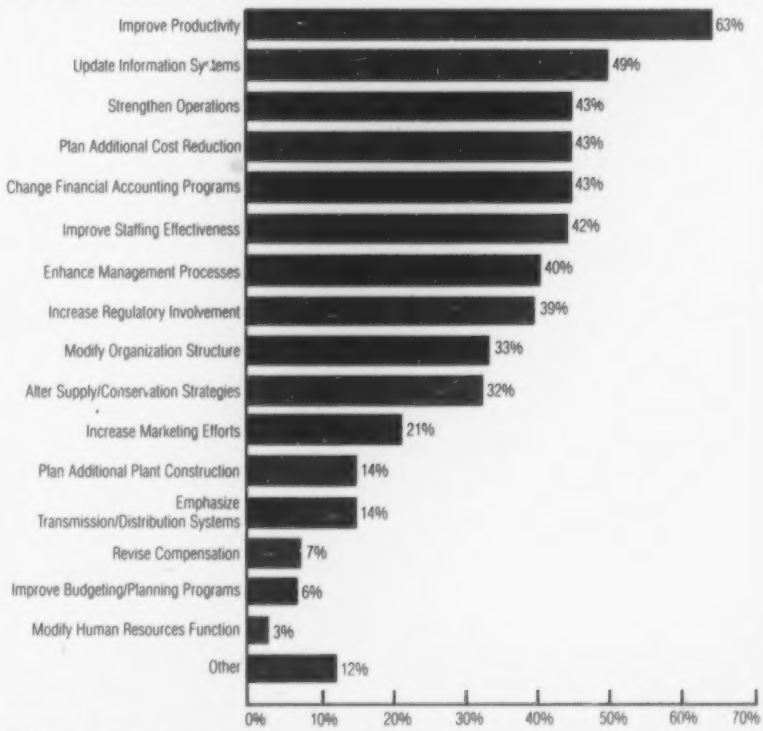
Regulatory issues scored a distant second with a weighted score of

Figure 1
Major Strategic Issues



Note: Numbers based on a weighting of respondents' 1st, 2nd, and 3rd choices (i.e., 3, 2, and 1 weight points, respectively).

Figure 2
Responses to Major Strategic Issues


Improve Productivity 63%
Update Information Systems 49%
Strengthen Operations 43%
Plan Additional Cost Reduction 43%
Change Financial Accounting Programs 43%
Improve Staffing Effectiveness 42%
Enhance Management Processes 40%
Increase Regulatory Involvement 39%
Modify Organization Structure 33%
Alter Supply/Conservation Strategies 32%
Increase Marketing Efforts 21%
Plan Additional Plant Construction 14%
Emphasize Transmission/Distribution Systems 14%
Revise Compensation 7%
Improve Budgeting/Planning Programs 6%
Modify Human Resources Function 3%
Other 12%
0% 10% 20% 30% 40% 50% 60% 70%

Note: Numbers represent percent of all respondents selecting the response.

104. The average rank of 2.08 indicates that although many people consider Regulation to be an important issue, most of them see it as secondary to a more pressing force.

Supply and Demand was an important issue, but to a smaller number of respondents. Supply and Demand issues received the highest average rank of the survey (2.49) from a weighted score of 97. Of those executives who see it as important, 59 percent ranked it #1.

Marketing, the other issue that received significant attention, had a weighted rank of 55, but a low average rank of 1.62.

Asked to identify what they thought their companies' "primary response" would be to the issue they ranked #1, 63 percent replied Improve Productivity (as shown in Figure 2).

Of those who selected competition as the #1 issue, 62 percent identified one of the top seven responses as their companies' "primary response." Of those who chose Regulation as the #1 issue, a predictably large percentage (67 percent) said that they plan to Increase Regulatory Involvement. Those who selected Supply/Demand as the top issue indicated that they are more than twice as likely to Alter Supply/Conservation Strategies (74 percent) and to Emphasize Transmission and Distribution Systems (35 percent) than the survey population as a whole. Less predictably, almost half (48 percent) of those who ranked Supply/Demand as the #1 issue Plan Additional Plant Construction.

Although Marketing was often selected as a key issue, Increasing Marketing Efforts was not often identified as a likely response, even by those who indicated marketing was important to them. In fact, none of those who selected Marketing as the #1 issue (and only 15 percent of those who selected Marketing at all) plan to Increase Marketing Efforts. The explanation may lie in the fact that 76 percent of those who identified Marketing as a key issue plan to Update Information Systems, which could be key to monitoring their operating environment and learning what competitors, potential competitors, customers, suppliers, and other industry players are doing and thinking.

Contributed by Cresap, McCormick and Paget

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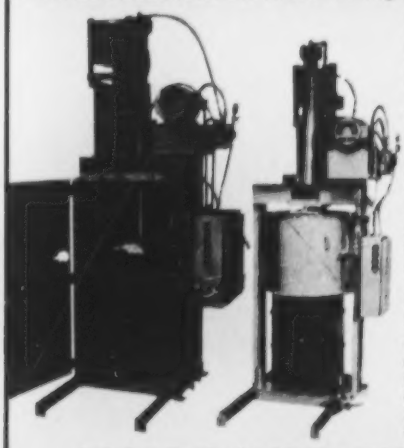

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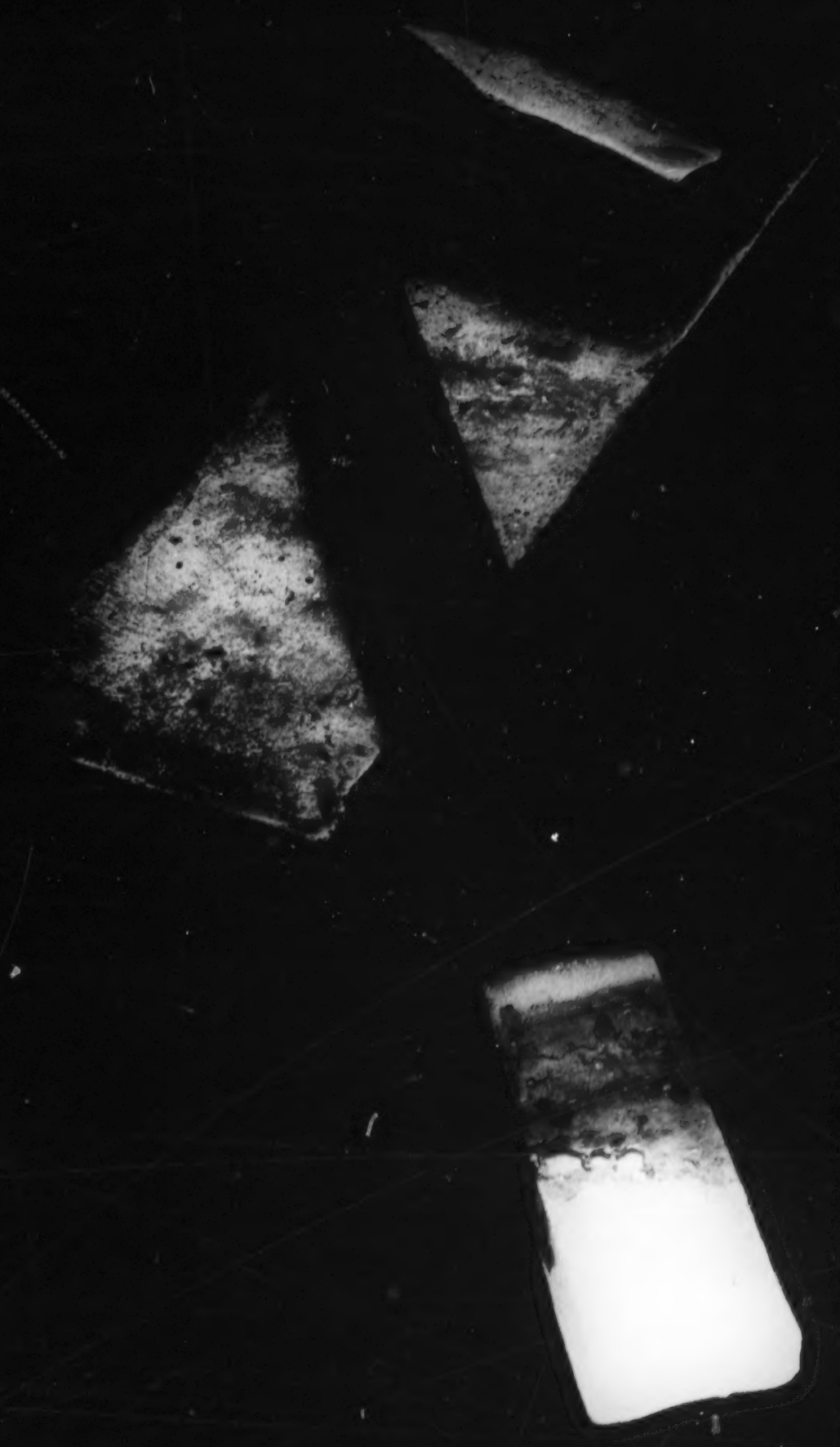

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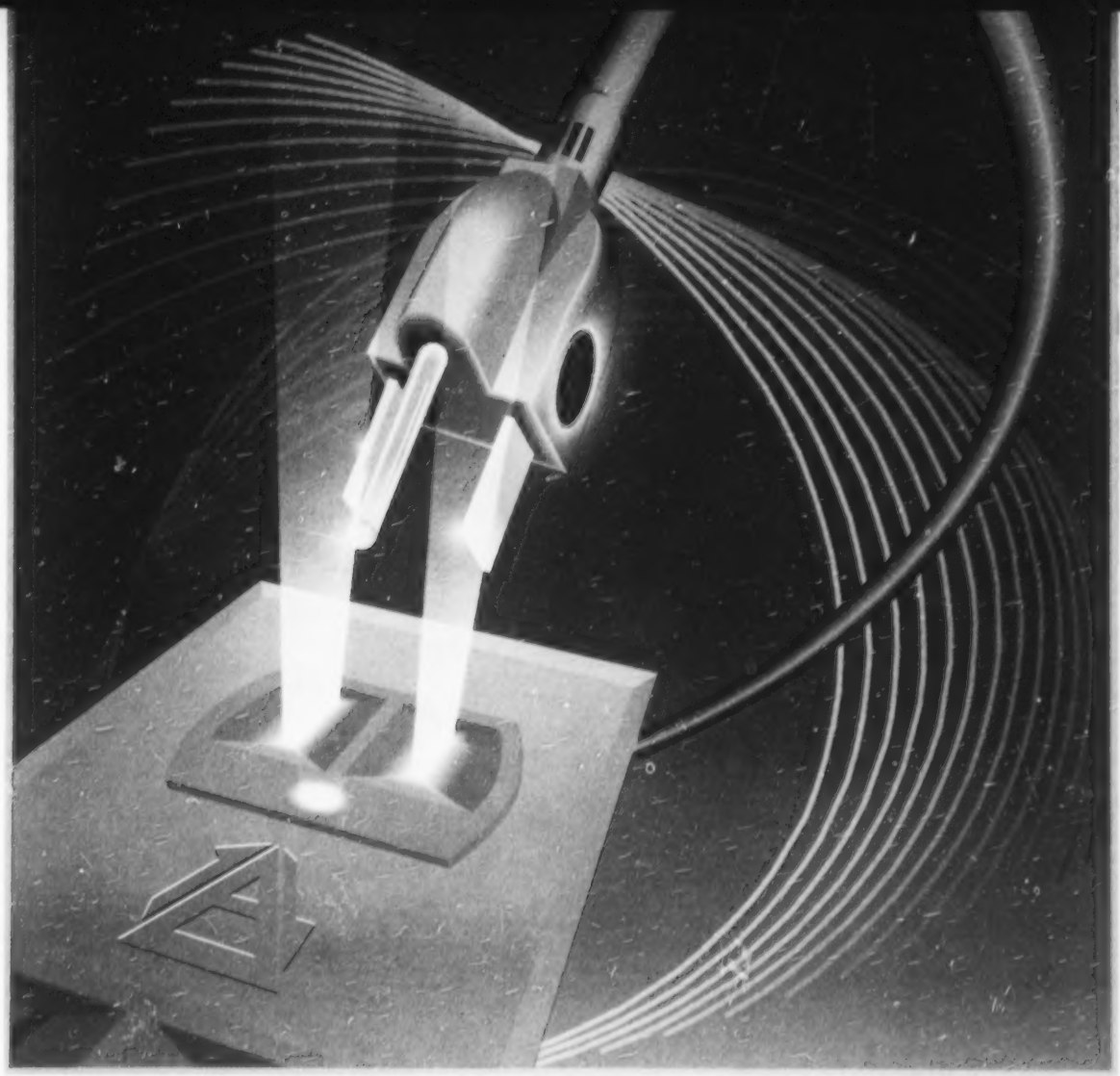

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